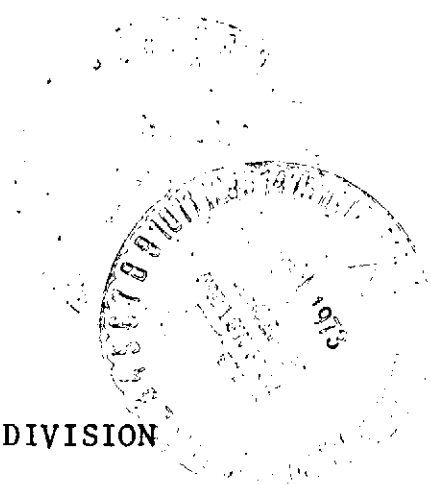
GP-1013
20 July 1973

# JOHN F. KENNEDY SPACE CENTER



# NASA-6
# ATMOSPHERIC MEASURING STATION



MEASUREMENT SYSTEMS DIVISION

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GP-1013

# NASA-6
# ATMOSPHERIC MEASURING STATION

MEASUREMENT SYSTEMS DIVISION

20 July 1973

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# SECTION I
# INTRODUCTION

## 1.1 PURPOSE

This document contains information required to calibrate, functionally check and operate the Instrumentation Branch equipment on the NASA-6 aircraft.

## 1.2 SCOPE

This document consists of all procedures required for preflight checks and in-flight operation of the NASA-6 Atmospheric Measuring Station. The calibration section is intended for only that portion of the system maintained and calibrated by IN-MSD-12 Systems Operation contractor personnel. Maintenance is not included in this document.

## 1.3 APPLICABLE DOCUMENTS

The following documents contain additional detailed information which may be required in operating and maintaining the system.

### 1.3.1 Manuals

- Mark II-A Operating and Maintenance Manual, Increa-Data Corporation, Albuquerque, New Mexico
- Operations and Service Manual, Model TR-888, Eight Channel Recorder, Techni-Rite Electronics, Inc., East Greenwich, Rhode Island
- Operations and Service Manual, Model TSC-801 Signal Conditioner, Techni-Rite Electronics, Inc., East Greenwich, Rhode Island
- Two-Way Land/Mobile Radiotelephone Owners Operating Manual, Standard Communications Corporation, Wilmington, California
- Description and Instruction Manual for the Cylindrical Field Mill System, NOAA Technical Memorandum ERL APCL-14
- Instruction Manual for Precision Radiation Thermometer Model PRT-5, Barnes Engineering Company, Stamford, Connecticut
- Instruction Manual, Cambridge Systems Model 137-C3 Aircraft Hygrometer System, Environmental Equipment Division, Waltham, Massachusetts

1.3.2 Drawings

- PC1-4400 Indentured Drawing List
- PC1-4401 Block Diagram
- PC1-4402 System Schematic
- PC1-4403 Cabling Diagram
- PC1-4406 Interior Equipment Location
- PC1-4723 Exterior Equipment Location

# SECTION II
# CONTROL AND INDICATOR IDENTIFICATION

## 2.1 GENERAL

Figures 2-1 through 2-16 show all front panel controls and indicators in the NASA-6 Atmospheric Measuring Station. Figure 2-17 is a block diagram which shows the relationship of the various system components. For additional information on individual equipment items, refer to the applicable manufacturer's manual, laboratory calibration procedure or PC-1 drawing.

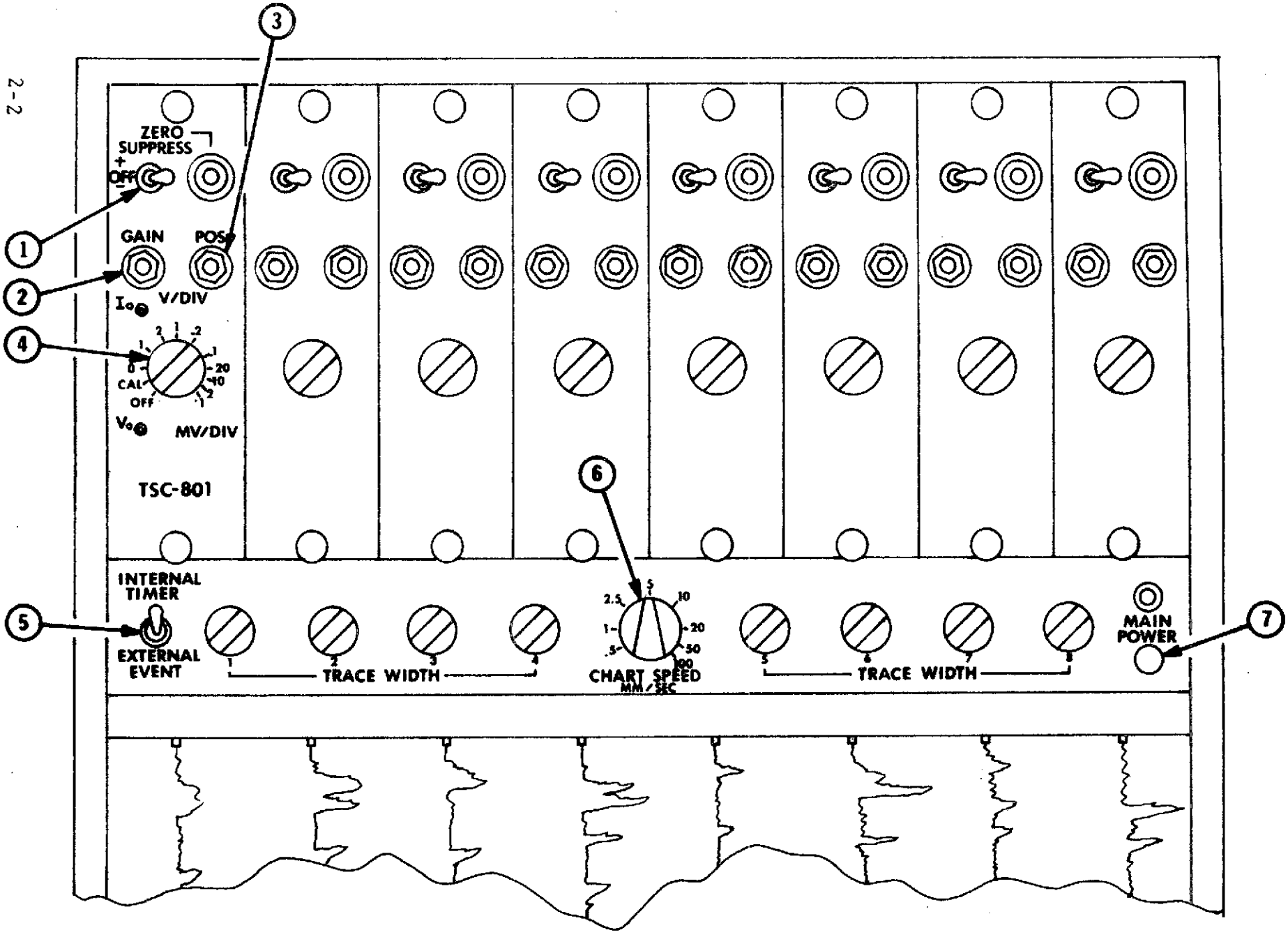



Figure 2-1. Techni-Rite 8 Channel Recorder

## 2.2 TECHNI-RITE 8 CHANNEL RECORDER (FIGURE 2-1)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | ZERO SUPPRESS switch | Not used - leave in center (OFF) position. |
| 2. | GAIN potentiometer | Adjusts amplifier gain - used to adjust full scale pen position when calibrating. |
| 3. | POS potentiometer | Adjusts amplifier pen position - used to adjust zero pen position when calibrating. |
| 4. | V/DIV, MV/DIV switch | Adjusts recorder range - leave on .1 V/DIV setting. |
| 5. | INTERNAL TIMER/EXTERNAL EVENT switch | Applies internal timing. |
| 6. | CHART SPEED switch | Changes chart speed - leave on 2.5 mm/sec for data recording. |
| 7. | MAIN POWER switch | Controls ac line power supply. |

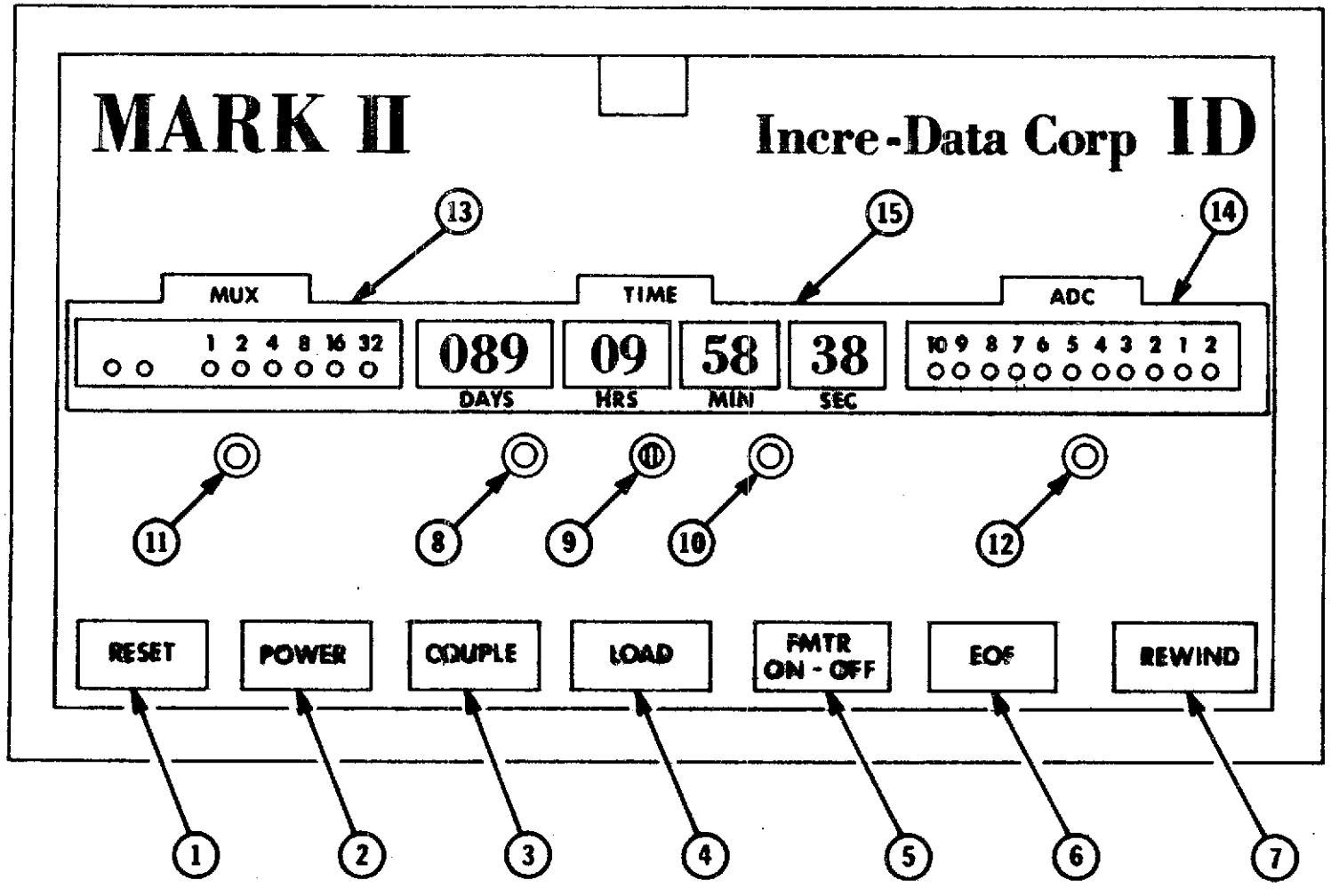



Figure 2-2. Incre-Data Mark II-A Digital Recorder

## 2.3 INCRE-DATA MARK II-A DIGITAL RECORDER (FIGURE 2-2)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | RESET button | Overrides all other commands, stops tape and resets formatter. When depressed with COUPLE or LOAD, acts as decouple or unload function. |
| 2. | POWER button | On/off dc power alternate action pushbutton. |
| 3. | COUPLE button | With tape cartridge locked in, permits tape to be drawn onto the recorder take-up reel. With RESET, disengages tape coupling. |
| 4. | LOAD button | Advances tape to beginning-of-tape (BOT) marker. With RESET, causes low speed rewind unload cycle. |
| 5. | FMTR ON-OFF button | With RESET on, initiates formatter recording. Pressing button again allows formatter to stop after completing the cycle it is in. |
| 6. | EOF button | Allows a computer compatible end-of-file gap on the tape when the formatter is off. |
| 7. | REWIND button | With RESET on, causes the tape to be rewound into the cartridge. High speed rewind continues to BOT. |
| 8. | Enable Clock Set button | Stops the clock and allows setting of each clock digit. Operates only in reset or stopped modes. |
| 9. | Decade Select Preset screw | A screwdriver-operated rotary selector switch. Selects clock decade (digit) to be set. Clockwise digits 1 through 9 of the TIME (14, figure 2-2) display may be selected and set. Leave screw slot in vertical or operate mode after use. |

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 10. | Update and Clock Start button | Advances selected digit once each time button is depressed. When screw switch is in the vertical (operate) position, depressing button starts the clock. |
| 11. | Mux Advance button | Used in reset or stopped mode to manually advance the multiplexer to any channel. Used only in reset or stopped mode. |
| 12. | ADC Digitize button | Manually activates the analog to digital converter. Set for same channel as that of the multiplexer. Used only in reset or stopped mode. |
| 13. | MUX display | Displays the channel from which the multiplexer is receiving data. May be used in connection with Mux Advance button to manually select channels. |
| 14. | ADC display | Displays the digital data output from the analog to digital converter. When a mux channel has been manually selected using the Mux Advance button, its digital value is displayed in ADC when the ADC Digitize button is depressed. Used in reset and stopped modes only. |
| 15. | TIME digital display | Manually set using the three controls under the display, the clock runs continuously until Enable Clock Set is again depressed. |

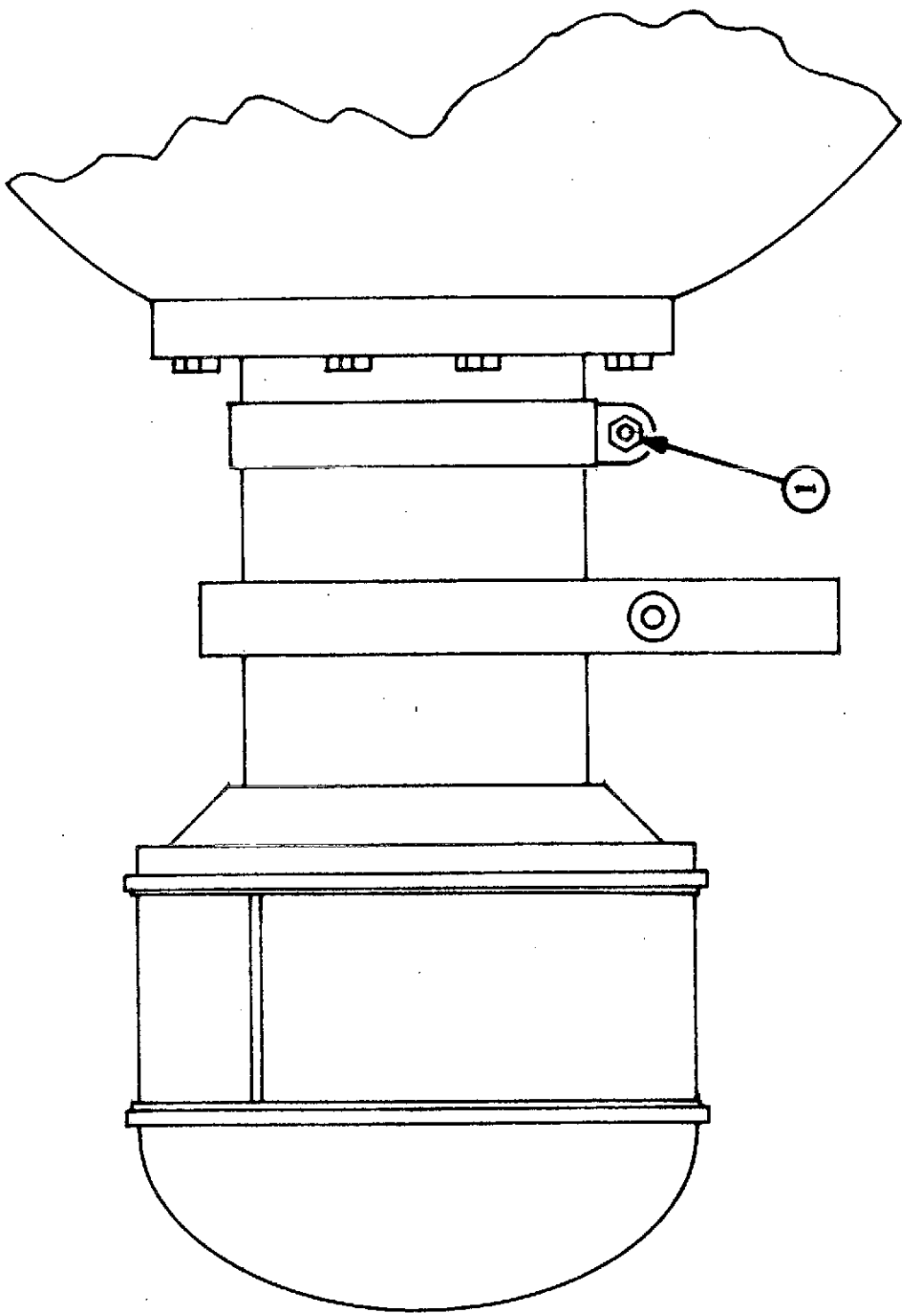



Figure 2-3. NASA-6 Nose Field Mill

## 2.4 NASA-6 NOSE FIELD MILL (FIGURE 2-3)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | Screw clamp | This clamp (on either Nose or Top Mill) can be loosened to turn the Field Mill to bring it within the adjustment range of the PHASE control (2, figure 2-4). |

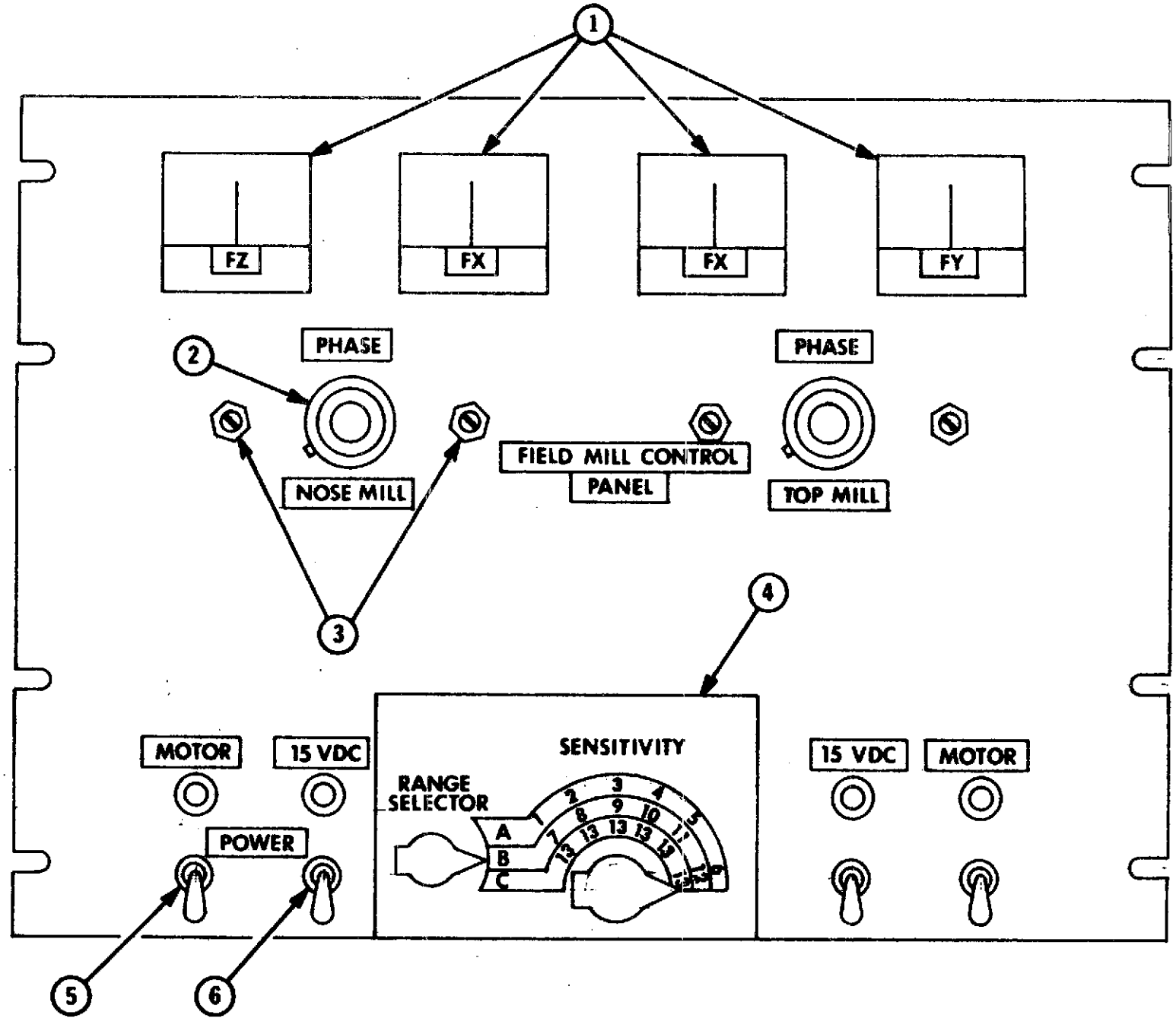



Figure 2-4. Field Mill Control Panel

## 2.5 FIELD MILL CONTROL PANEL (FIGURE 2-4)

NOTE

Left and right-hand controls are for duplicate systems; only the left are described.

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | Field Meters | Indicate relative electrostatic field around the Field Mills. A positive charge overhead causes a positive deflection in the FZ meter. A positive charge to the right of the aircraft causes a positive deflection in the FX meter, and a positive charge in front of the aircraft causes a positive deflection of the FY meter. These three axes make up a three dimensional coordinate system (X, Y and Z) about the aircraft. |
| 2. | PHASE control | Rotates the coordinate system about the Field Mill axis. For a charge directly under or above the Nose Mill, adjust the PHASE control for zero on the FX meter. |
| 3. | R47 and R82 | Gain controls adjusted during calibration. |
| 4. | SENSITIVITY and RANGE SELECTOR | Adjusts full scale range of field meters as follows: |

| | | |
|---|---|---|
| A RANGE | 1 - 500 | KV/M |
| | 2 - 250 | KV/M |
| | 3 - 100 | KV/M |
| | 4 - 50 | KV/M |
| | 5 - 25 | KV/M |
| | 6 - 10 | KV/M |
| B RANGE | 7 - 5 | KV/M |
| | 8 - 2.5 | KV/M |
| | 9 - 1.0 | KV/M |
| | 10 - 500 | V/M |
| | 11 - 250 | V/M |
| | 12 - 100 | V/M |
| C RANGE | 13 - 50 | V/M |

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 5. | MOTOR switch | Energizes 115 Vac power circuit to the Field Mill motor. |
| 6. | DC switch | Energizes 115 Vac power circuit to the control panel dc supply. |

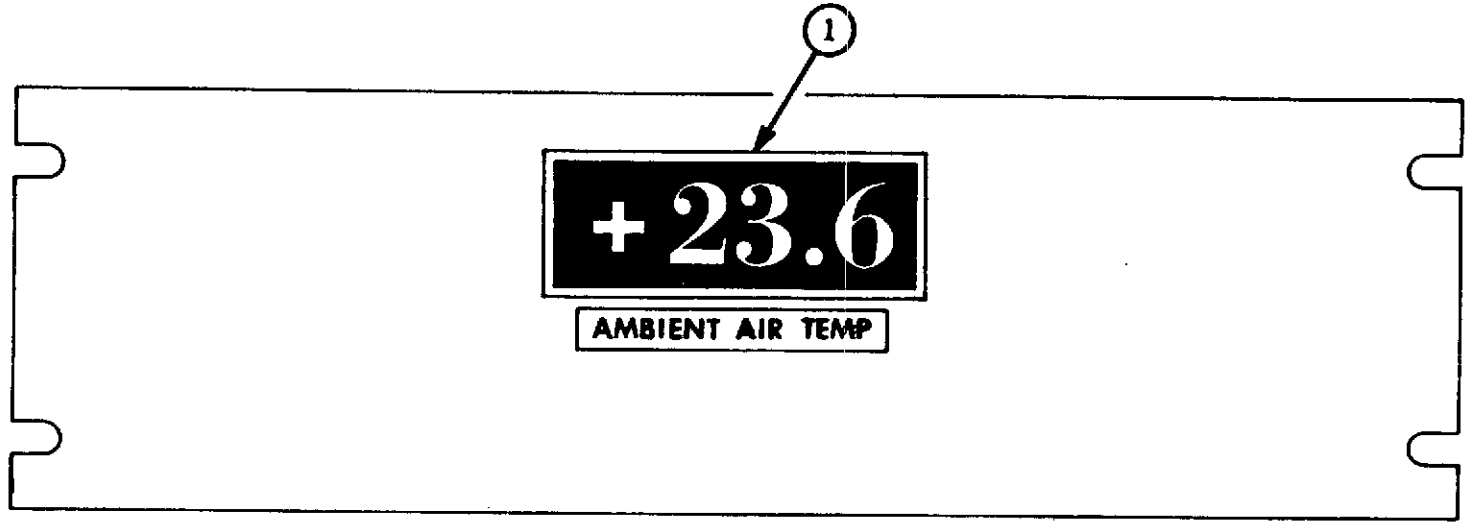



Figure 2-5. Ambient Air Temperature Panel

## 2.6 AMBIENT AIR TEMPERATURE PANEL (FIGURE 2-5)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | Numeric display | Indicates ambient air temperature from -100 to +100 degrees Celsius (°C). |

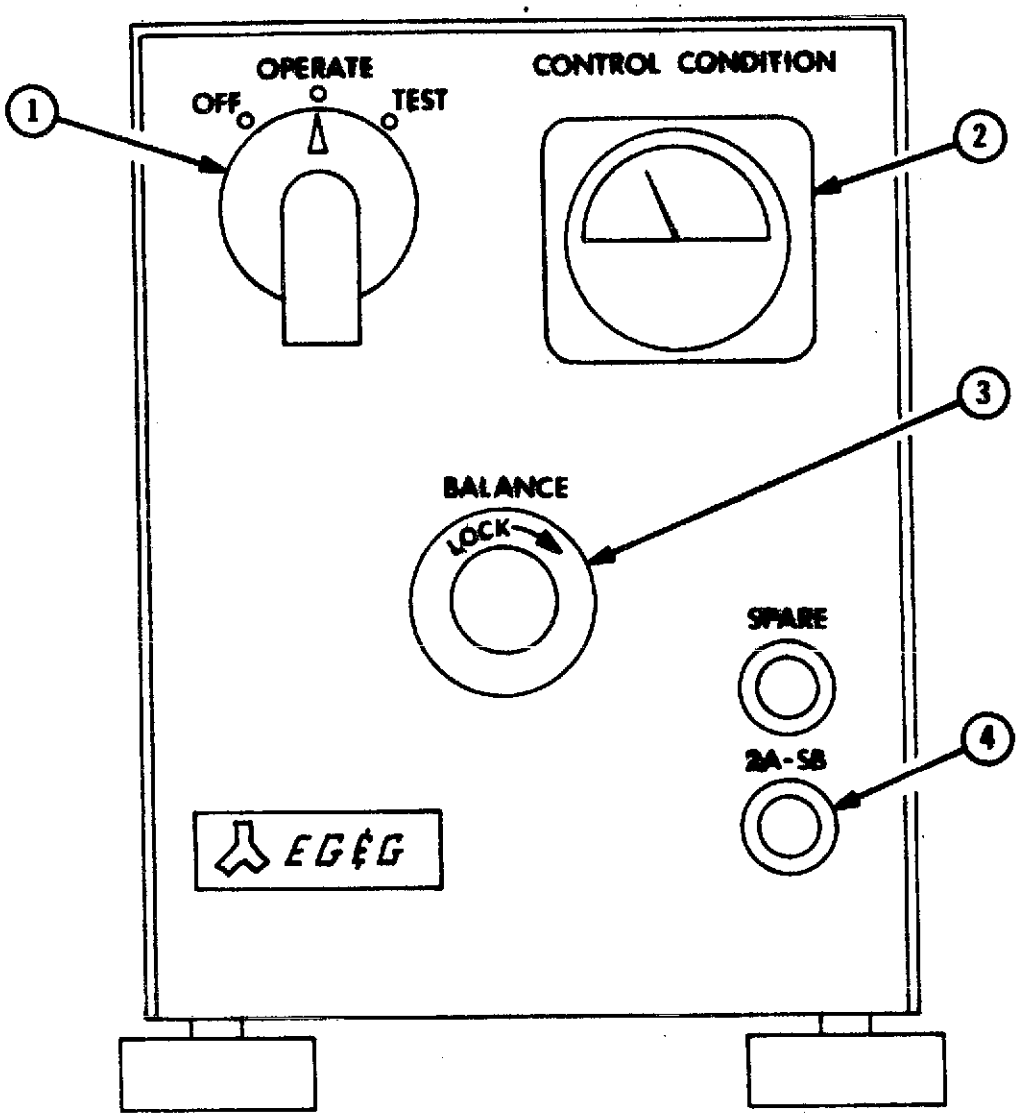



Figure 2-6. Hygrometer Control

## 2.7 HYGROMETER CONTROL (FIGURE 2-6)

| ITEM | CONTROL/INDICATION | FUNCTION |
|---|---|---|
| 1. | OFF/OPERATE/TEST switch | Provides ac power to the system and controls mode of operation: OPERATE - dew point can be recorded; TEST - heats mirror in transducer to permit balancing; unmarked maximum clockwise position provides maximum cooling to mirror and lowest output level (dew point) to recorder. |
| 2. | CONTROL CONDITION meter | Indicates cooling current going to transducer mirror. After cooling off period in OPERATE, the current will drop to .1 - .3 ma for high humidity or .5 - .9 ma for low humidity. A reading of over .9 ma indicates dew point data is in error. |
| 3. | BALANCE potentiometer | Adjusted for maximum indication on meter (approximately mid scale). Smaller readings indicate contamination on the mirror. |
| 4. | 2A-SB | Fuse holder, ac power, two amp slow blow. |

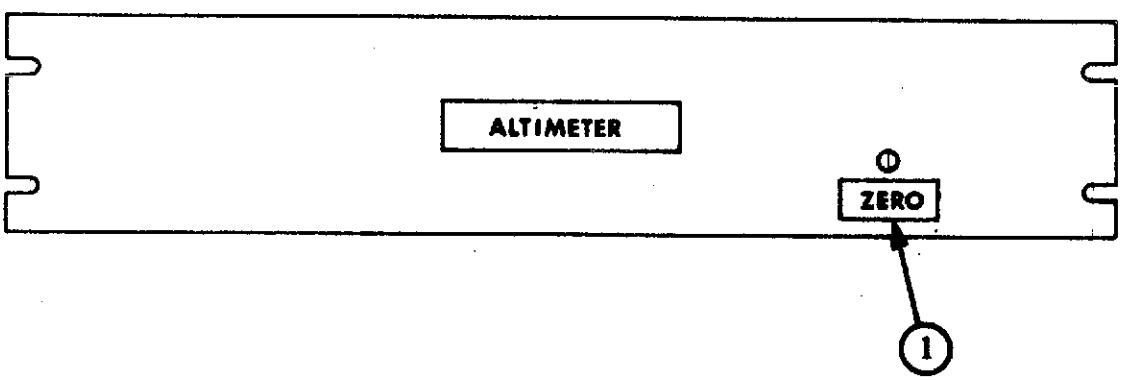



Figure 2-7. Altimeter Panel

## 2.8 ALTIMETER PANEL (FIGURE 2-7)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | ZERO control | Adjusts altimeter to compensate for daily fluctuations in barometric pressure. Set for zero before flight. |

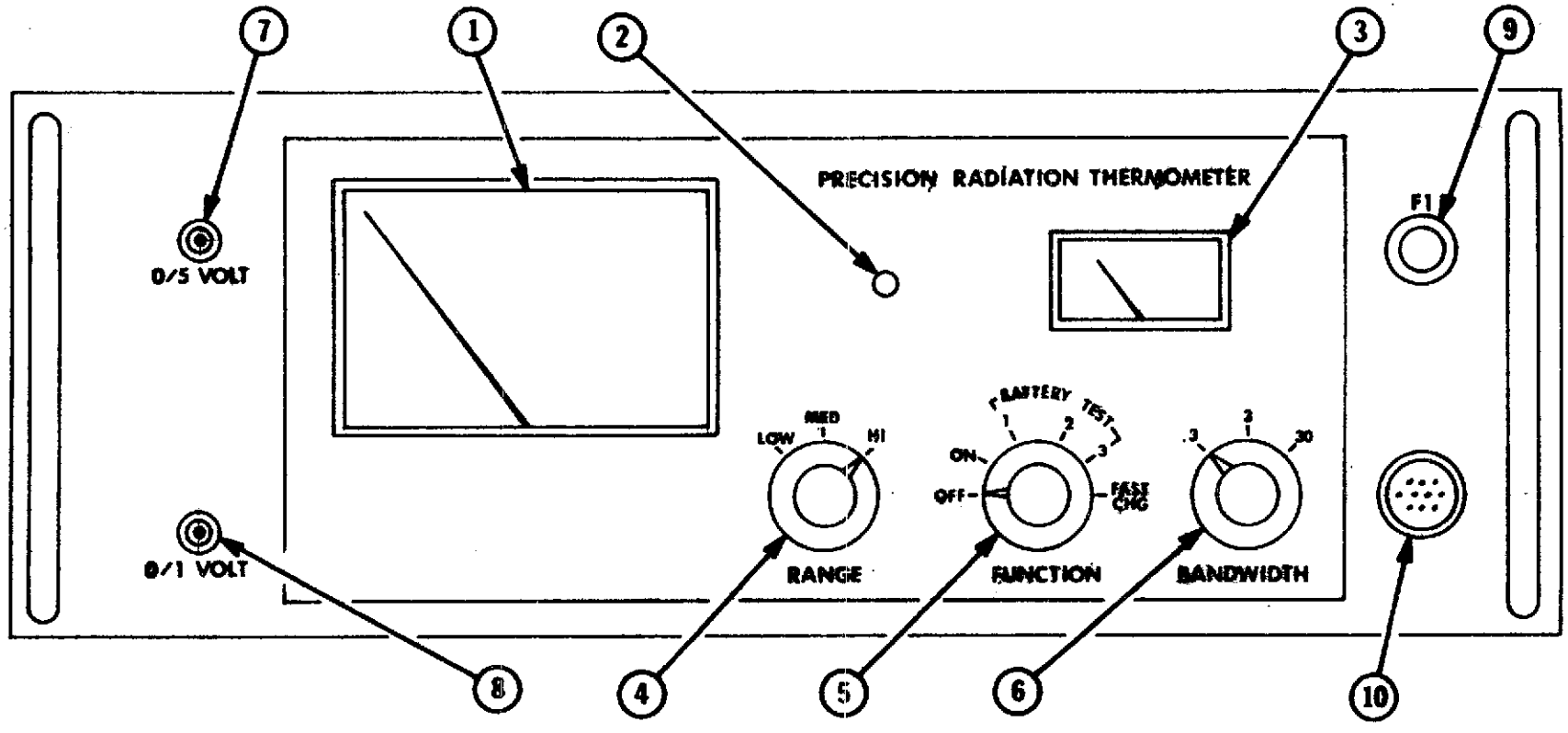
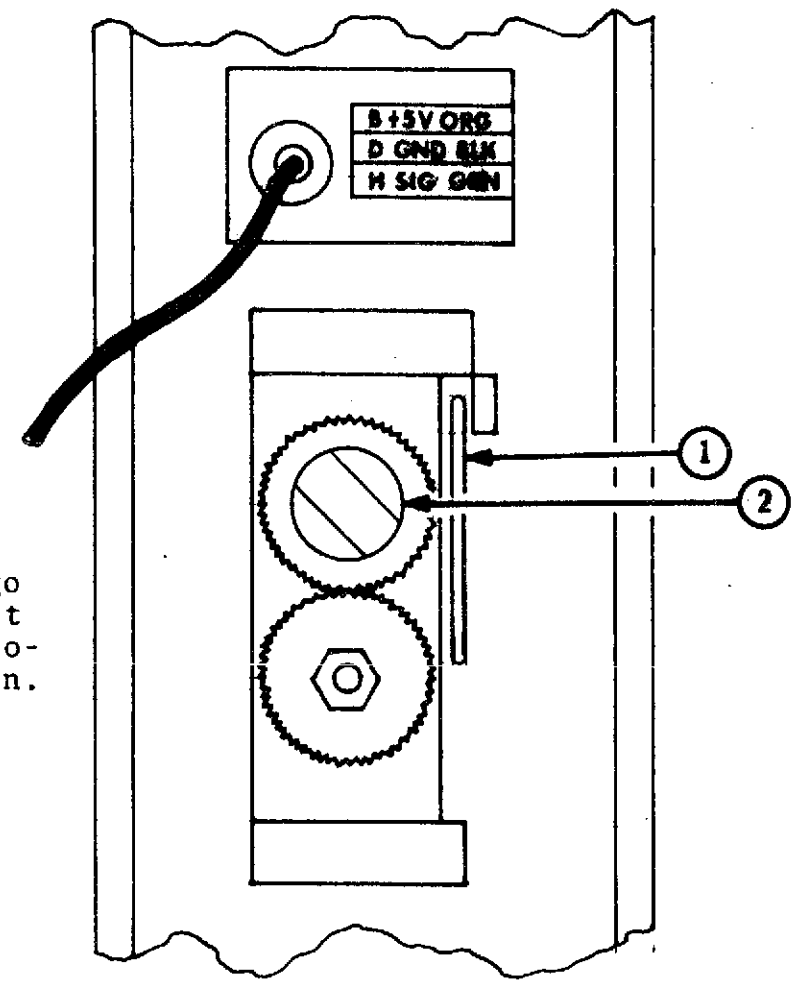



Figure 2-8. Radiometer Control Panel

## 2.9 RADIOMETER CONTROL PANEL (FIGURE 2-8)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | Output Meter | Three temperature scales: -20 to +15°C (LOW); +10 to +45°C (MED); +40 to +75°C (HI). |
| 2. | Line Power Lamp | Illuminates when line power is turned on. |
| 3. | Cavity Control Meter | For battery voltage checks and status of temperature controlled reference cavity. Cavity is ready for use when meter is in the white range. |
| 4. | RANGE switch | Controls range of meter; LOW, MED, HI. |
| 5. | FUNCTION switch | ON is normal operating position; 1, 2, 3 and FAST CHG relate to batteries. |
| 6. | BANDWIDTH switch | Controls frequency response of output (normally set on .3). |
| 7. | 0/5 VOLT | High level output to recorder - duplicated on back of panel. |
| 8. | 0/1 VOLT | Low level output to recorder - duplicated on back of panel. |
| 9. | F1 fuse | Fuse for ac line. |
| 10. | Connector | Input connector for radiometer sensor - duplicated on back of panel. |




NOTE

Mirror control mounted in cargo door window just to left of Radiometer sensor can.

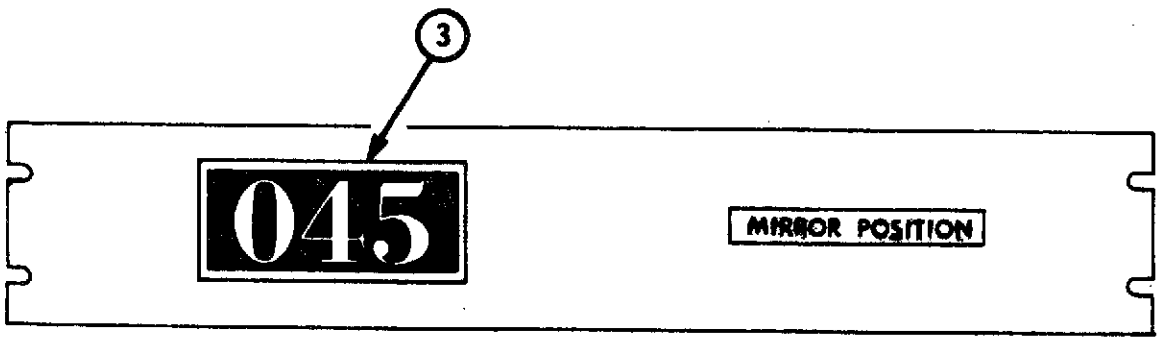



Figure 2-9. Radiometer Mirror Control and Display

## 2.10 RADIOMETER MIRROR CONTROL AND DISPLAY (FIGURE 2-9)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | Lever | Locks mirror into position for use. |
| 2. | Control knob | Rotates mirror from 0° (full clockwise) to 180° (full counterclockwise). |
| 3. | Numeric display | Displays mirror position from 0° (up) through 180° (down). |

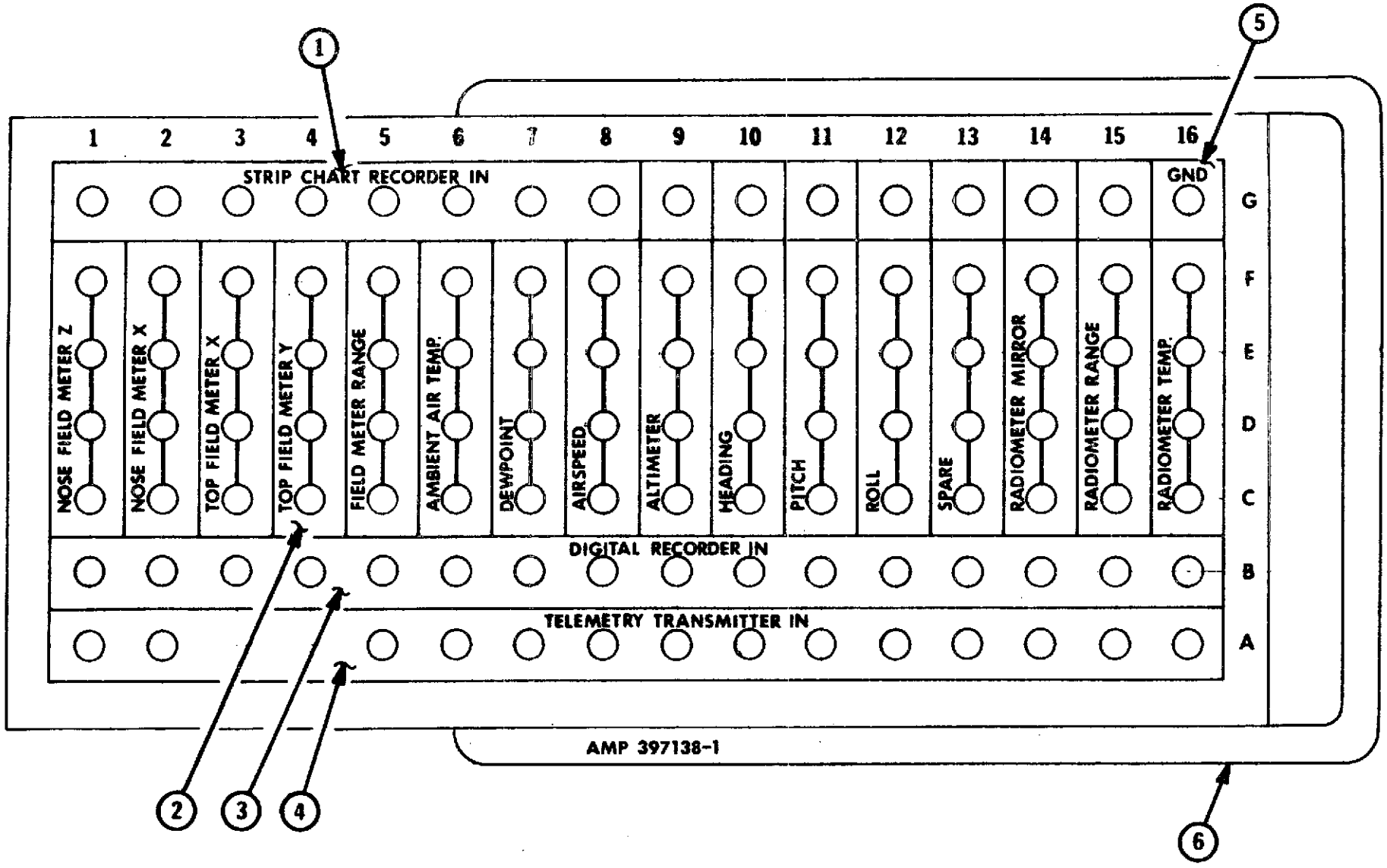



Figure 2-10. System Patch Panel

## 2.11 SYSTEM PATCH PANEL (FIGURE 2-10)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | STRIP CHART RECORDER IN | Eight jacks for output to the 8-channel Techni-Rite strip-chart recorder. May be parallel patched to a voltage source for simultaneous calibration of all channels. |
| 2. | NOSE FIELD METER Z, NOSE FIELD METER X, TOP FIELD METER X, TOP FIELD METER Y | These 16 slots are for the input from 16 measurements or their conditioners. Each channel has four paralleled jacks which may be patched to as many as four recording or display devices. |
| 3. | DIGITAL RECORDER IN | Sixteen-channel output to the Incre-Data digital recorder. Any unused channels must be terminated with a shorting plug. |
| 4. | TELEMETRY TRANSMITTER IN | Sixteen channels for output to a telemetry transmitter. Not used at present. |
| 5. | GND | Reference ground. |
| 6. | Patch panel latch | Move to left to remove patch board for installation of calibration patch board, etc. |

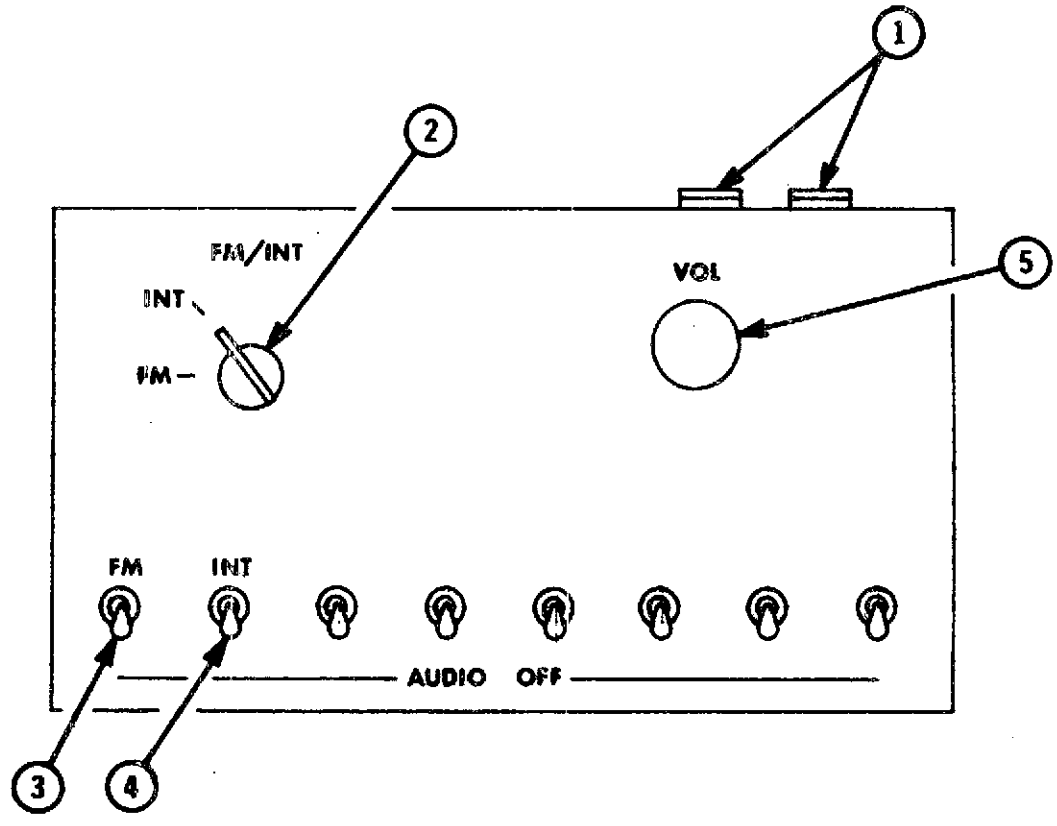



Figure 2-11. Aircraft Intercom System

## 2.12 AIRCRAFT INTERCOM SYSTEM (FIGURE 2-11)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | Jacks | For connecting headset. |
| 2. | FM/INT switch | To speak over aircraft intercom, place in INT position. To speak over the VHF-FM transceiver, place in FM. |
| 3. | FM switch | Place in up position to listen to the VHF-FM transceiver. |
| 4. | INT switch | Place in up position to listen to aircraft intercom. FM and INT switches may be left up (on) together. The other switches are not used and should be left down (off). |
| 5. | VOL potentiometer | Adjust for comfortable listening on aircraft intercom (VHF-FM transceiver volume is set on the transceiver). |

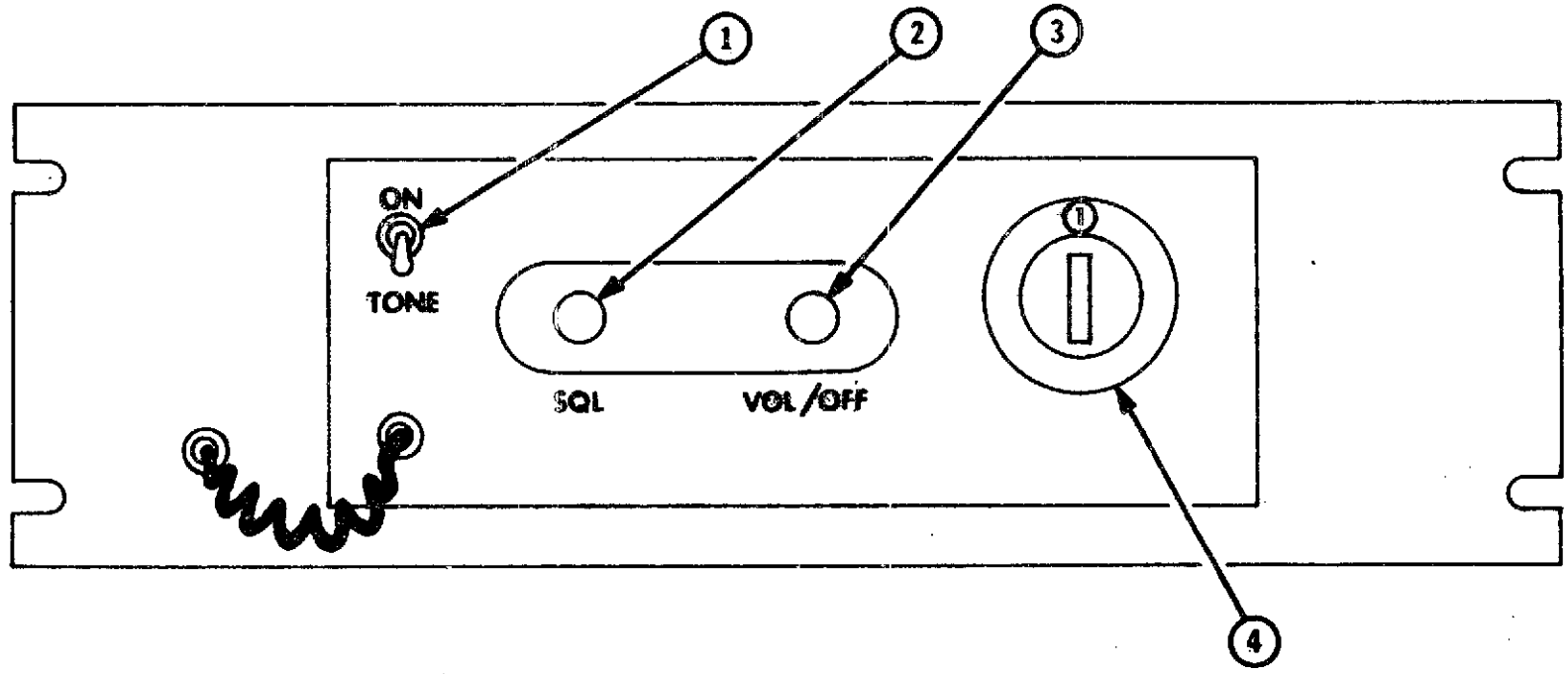



Figure 2-12. VHF Transmitter/Receiver (Standard SR-CB51T)

## 2.13 VHF TRANSMITTER/RECEIVER (FIGURE 2-12)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | TONE switch | Not used; leave down (off). |
| 2. | SQL potentiometer | Squelch should be adjusted just enough to quiet hiss and static from the receiver. |
| 3. | VOL/OFF switch | Used to turn on the transceiver and adjust listening volume. After aircraft intercom system volume is set, adjust this control for comfortable listening level. |
| 4. | Channel selector switch | Changes crystal controlled frequency of operation. This transceiver operates on 165.1875 mHz (Net 102) and the switch is left in the 1 position. |

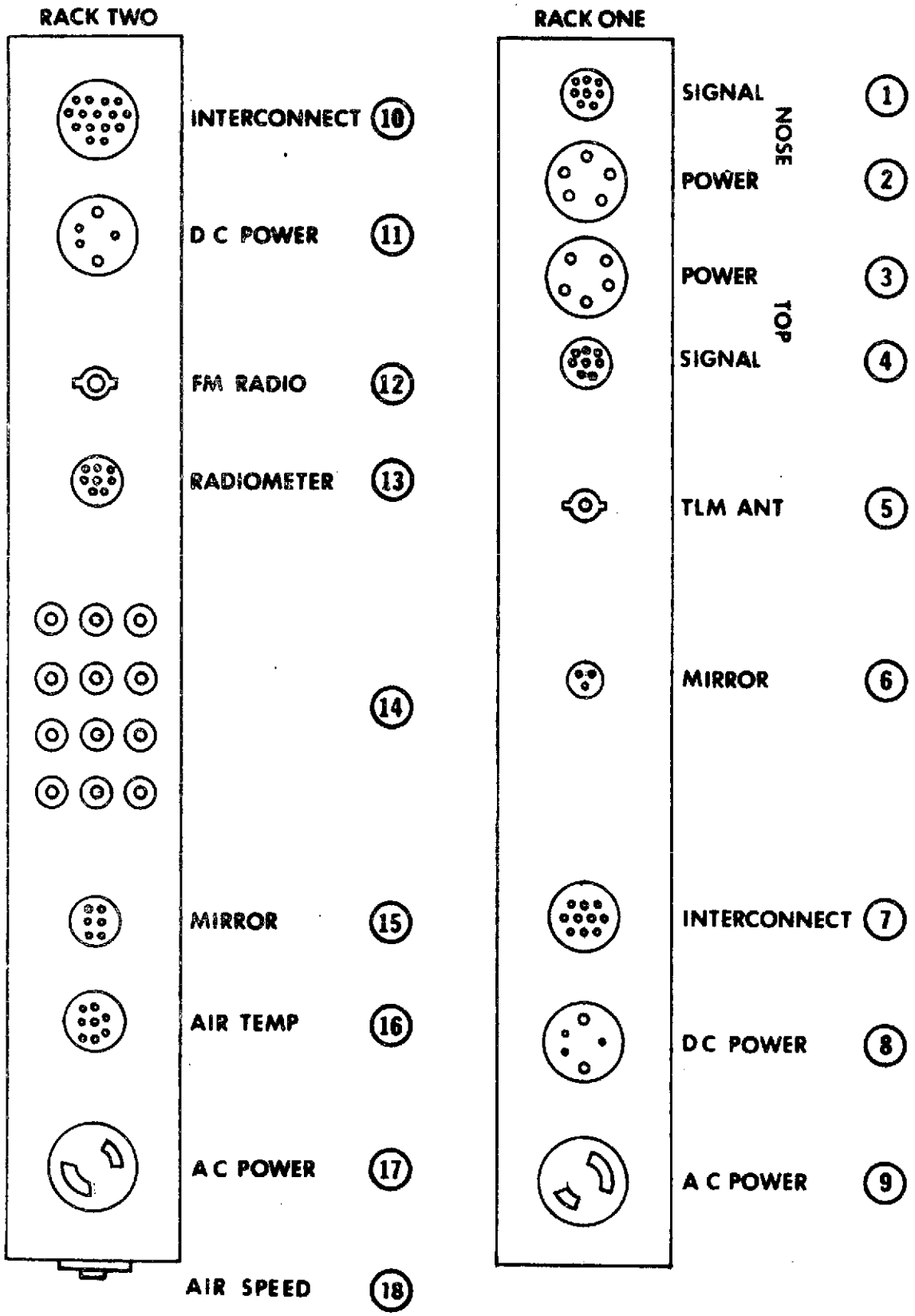



Figure 2-13. System Interconnect Bulkheads

## 2.14 SYSTEM INTERCONNECT BULKHEADS (FIGURE 2-13)

| ITEM | CONNECTOR | FUNCTION |
|---|---|---|
| 1. | NOSE SIGNAL | Nose Field Mill signal input. |
| 2. | NOSE POWER | Nose Field Mill 115 Vac power output. |
| 3. | TOP POWER | Top Field Mill 115 Vac power output. |
| 4. | TOP SIGNAL | Top Field Mill signal input. |
| 5. | TLM ANT | Not used. |
| 6. | MIRROR | Positions signal input from radiometer mirror. |
| 7. | INTERCONNECT | Interconnecting cable from rack two. |
| 8. | DC POWER | Aircraft 28 Vdc power input. |
| 9. | AC POWER | 115 Vac power output to rack two. |
| 10. | INTERCONNECT | Interconnecting cable from rack one. |
| 11. | DC POWER | Aircraft 28 Vdc power input. |
| 12. | FM RADIO | Antenna lead for VHF-FM transceiver. |
| 13. | RADIOMETER | Input from second radiometer mounting position (in floor). |
| 14. | N/A BNC's | Not used. |
| 15. | MIRROR | Positions signal input from radiometer mirror. |
| 16. | AIR TEMP | Input from air temperature transducer. |
| 17. | AC POWER | Input of ac power from rack one. |
| 18. | AIRSPEED | Input from airspeed transducer. |

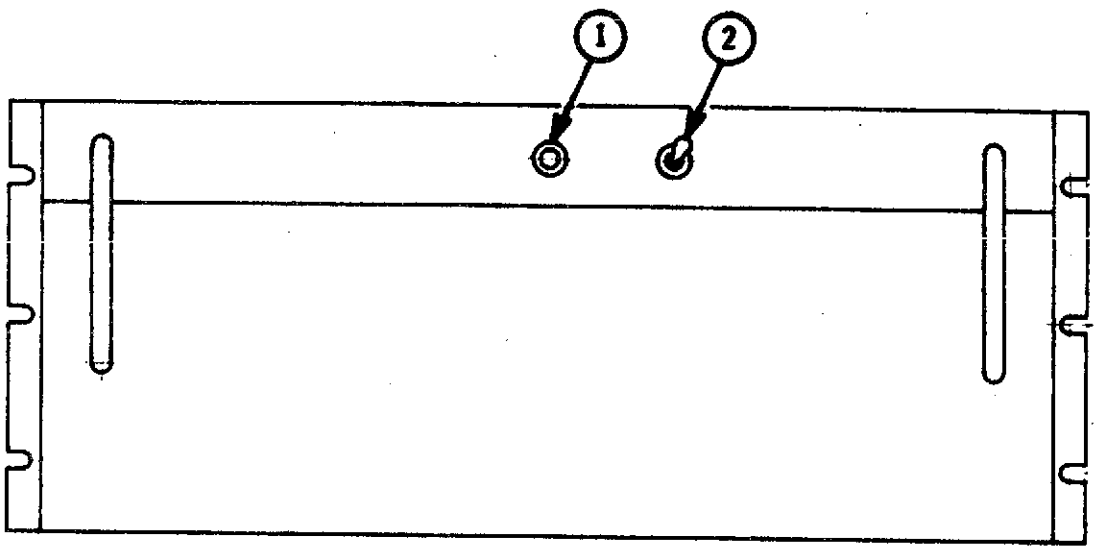



Figure 2-14. AC Power Inverter (Topaz Model 1000 GW-12-24-60)

## 2.15 AC POWER INVERTER (TOPAZ MODEL 1000 GW-12-24-60) (FIGURE 2-14)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | Pilot lamp | Illuminated when inverter is operating. |
| 2. | ON/OFF switch | Applies 28 Vdc to the inverter. Up position is on. |

NOTE

The inverter rating is 115 Vac at 8.4 amps. Do not exceed a 970 watt total load. Do not power up the inverter with load applied.

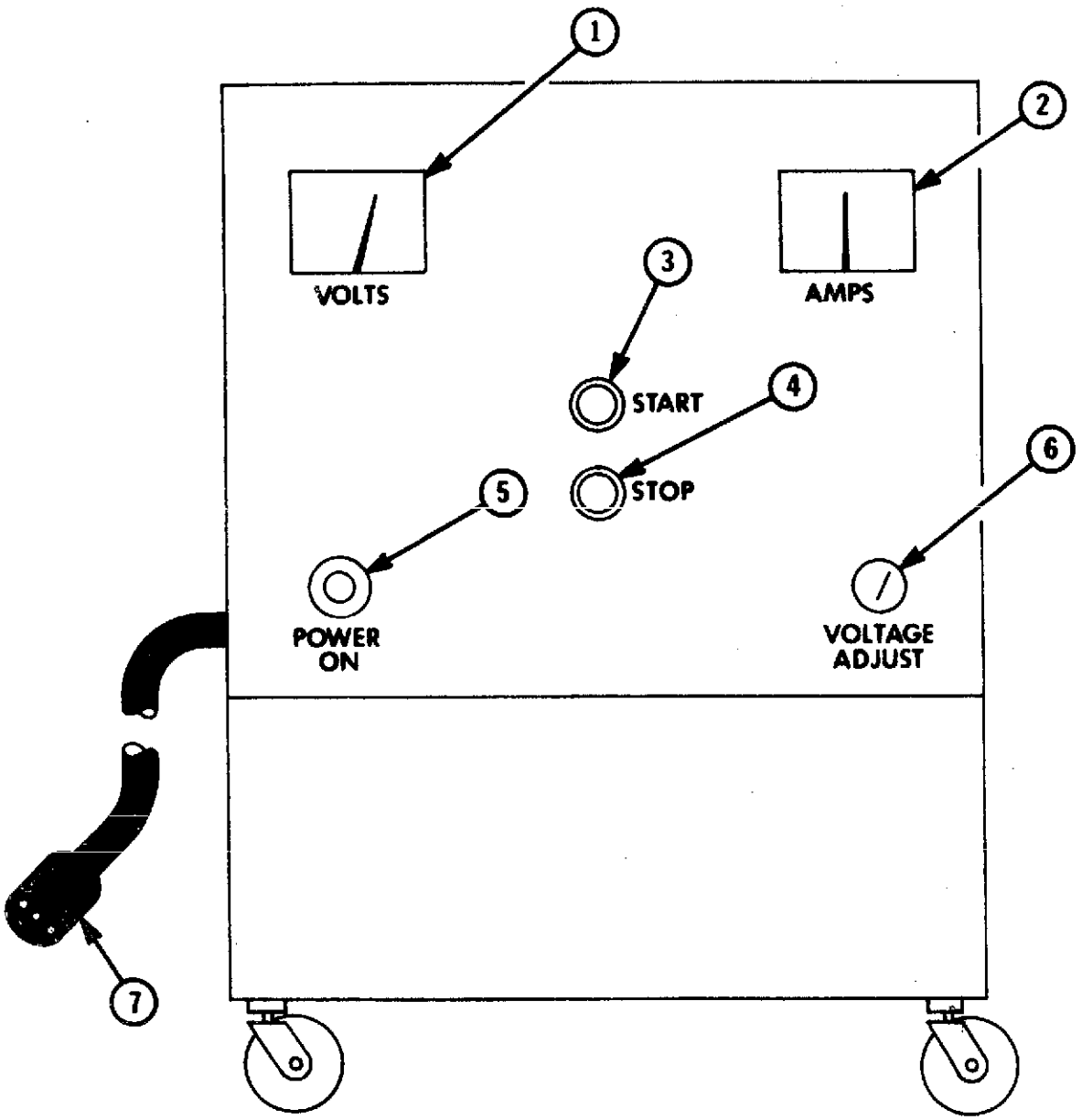



Figure 2-15. NASA-6 Ground 28V Power Supply

## 2.16 NASA-6 GROUND 28V POWER SUPPLY (FIGURE 2-15)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | VOLTS meter | Registers dc output voltage. |
| 2. | AMPS meter | Current output of dc supply. |
| 3. | START switch | Press to power up supply. |
| 4. | STOP switch | Press to power down supply. |
| 5. | POWER ON indicator | Indicates ac input power to the supply. |
| 6. | VOLTAGE ADJUST potentiometer | Adjusts dc output voltage. Set for 24.5 volts by meter (28V actual supply voltage). Should be adjusted with supply disconnected from aircraft, then shut down before connection. |
| 7. | Output connector | Connects to engine housing. |

NOTE

This power supply is not IN-MSD property; coordinate with aircraft mechanic before connecting to aircraft. Remove canvas top cover before use.

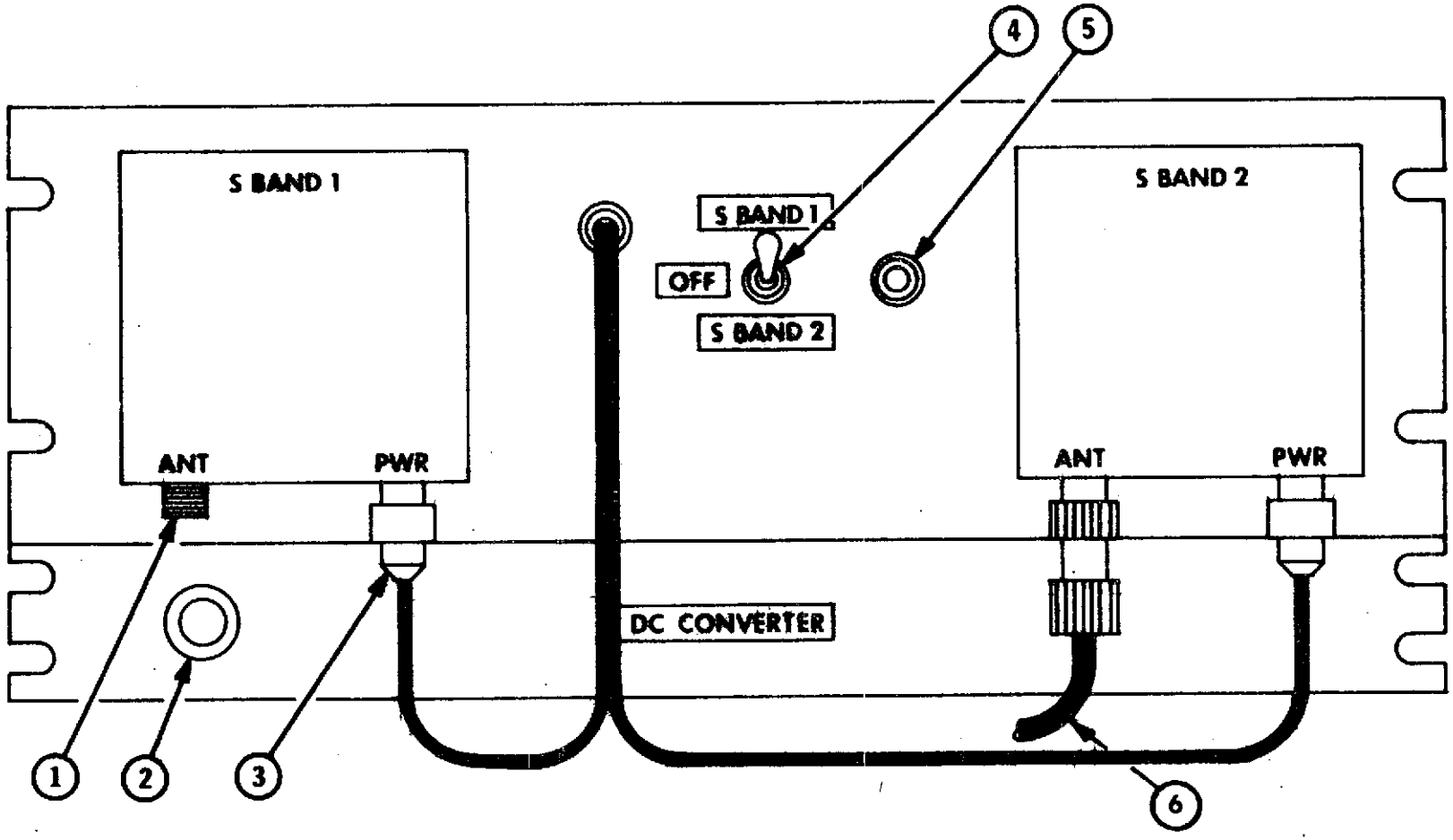



Figure 2-16. S-Band Transmitters and DC Converter

## 2.17 S-BAND TRANSMITTERS AND DC CONVERTER (FIGURE 2-16)

| ITEM | CONTROL/INDICATOR | FUNCTION |
|---|---|---|
| 1. | Antenna Connector | S-band antenna connections (must be connected before S-band transmitter is powered up). |
| 2. | Fuse holder | Supplies power to dc converter which divides 28 Vdc down to 12 Vdc for the VHF-FM transceiver. |
| 3. | Power Connection | S-band power input. |
| 4. | S BAND 1/OFF/S BAND 2 switch | Controls power to S-band transmitters. Up is on for transmitter 1, center is off, down is on for transmitter 2. |
| 5. | Circuit breaker | Press to reset power for S-band 1 or 2. |
| 6. | Antenna | Cable to the S-band antenna connected to the transmitter to be powered up. |

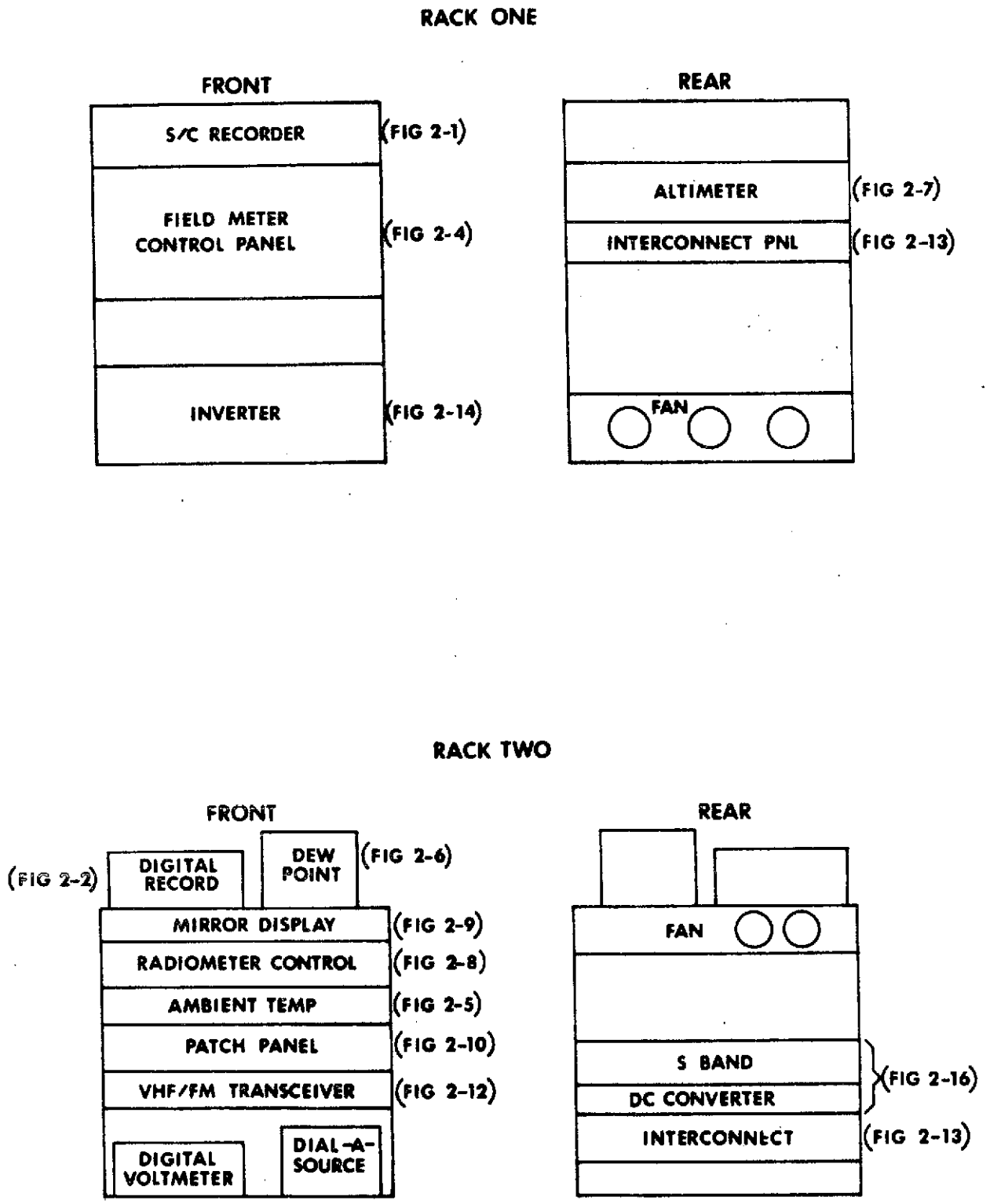



Figure 2-17. Rack Elevations

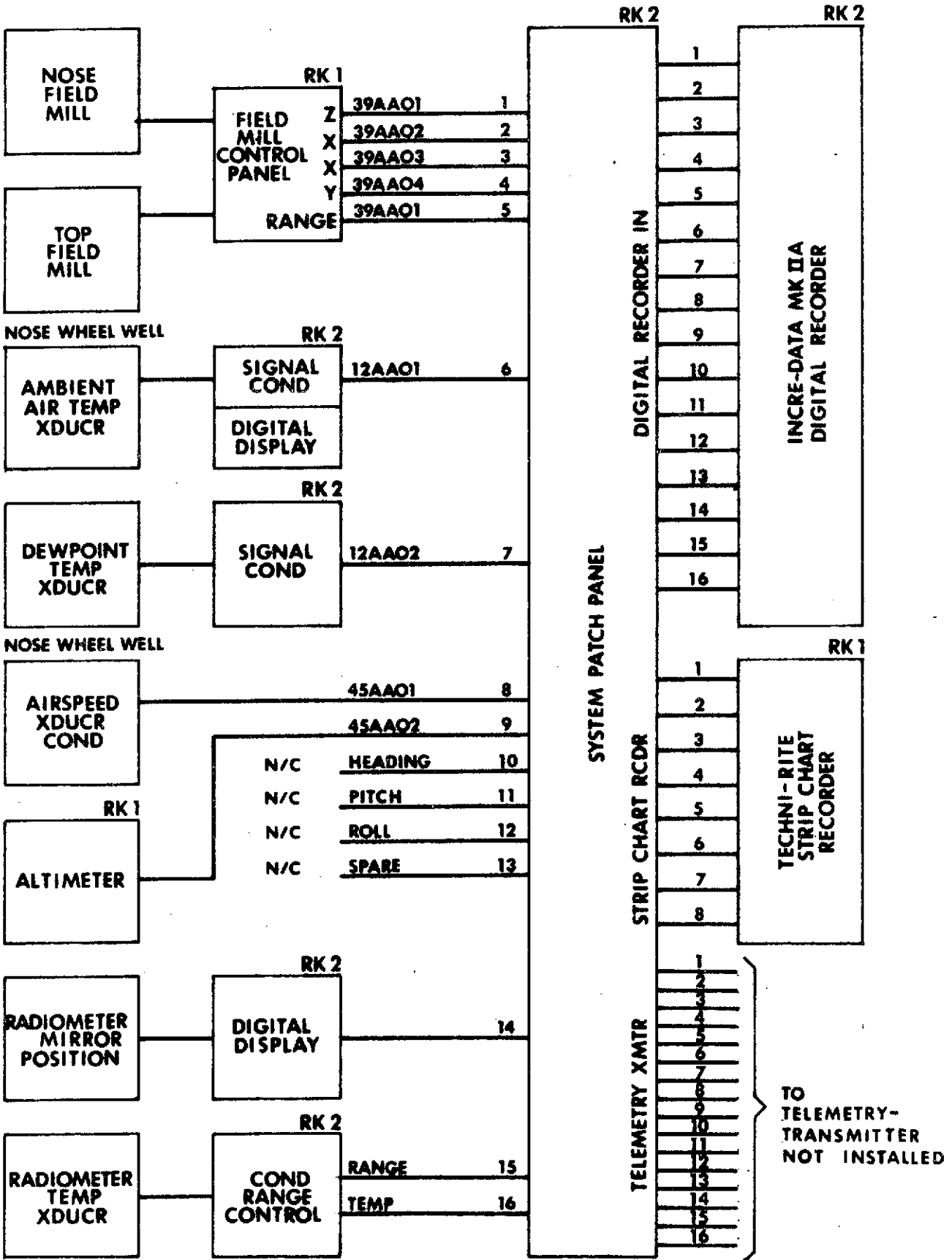



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Figure 2-18. System Block Diagram

# SECTION III
# CALIBRATION

## 3.1 GENERAL

The purpose of calibration is to allow measurements made to be related to some standard reference. Without calibration, measurement accuracy cannot be determined, and data acquired must be considered invalid.

The following paragraphs define calibration intervals for laboratory calibrated equipment and present detailed calibration procedures for field calibrated equipment. Test equipment is not covered. The operator is responsible for ensuring that test equipment calibration stickers are current before using the equipment.

## 3.2 REQUIRED TEST EQUIPMENT

- Fluke 8100A digital multimeter or equivalent
- Dial-A-Source power supply (reference voltage) or equivalent
- HP-202A or equivalent signal generator
- Stylus pressure gage

## 3.3 STRIP CHART RECORDER

Techni-Rite Electronics Inc., Model TR-888
8 channel
Calibration interval - three months

### 3.3.1 Mechanical

a. Mechanical maintenance of the recorder should be completed before calibration. This includes lubrication of stylus lifter cam surface, chart mandrel mounts and chart drive chain with a light film of grease; oiling the four shafts extending through the transmission end plates; and tightening the pen motor mounting screws and pen motor mounting strut screws, all covered by the manufacturer's manual.

b. Inspect the writing elements of all analog styli. Replace those styli whose writing elements show signs of excessive wear or abuse, such as flattening or cracking at the welded joints, bent heaters, and bent stylus struts.

c. Remove signal conditioner modules. Apply line power to the recorder and run two to three feet of chart at approximately 5 mm/sec chart speed.

d. Traces should be within ±1 mm of their respective channel centerlines; if not, they must be adjusted according to the instructions in the manufacturer's manual.

e. Reinstall signal conditioner modules.

f. Check the writing pressure of each stylus as follows

(1) Chart must be moving at a slow speed (1 to 5 mm/sec) with trace width controls adjusted for a fine trace.

(2) Place the blade of the pressure gage under the tip of the stylus heater and lift straight up. Read the gage just as the stylus leaves the chart (stops writing).

(3) Stylus pressure should be in the range between two and four grams.

(4) To adjust stylus pressure, carefully apply slight up or down finger pressure to each of the stylus struts at the rear of the stylus where the struts are attached to the stylus body. Pressure down will increase stylus pressure; pressure up will decrease stylus pressure.

3.3.2 Recorder Calibration

a. Set CHART SPEED switch to 1 or 5 mm/sec and adjust TRACE WIDTH controls for a fine trace on all channels.

b. Turn round locking knobs on GAIN and POS controls (2 and 3, figure 2-1) counterclockwise 1/2 to 2/3 turn to unlock controls, then turn each locking knob clockwise until GAIN and POS controls are partially restrained from rotating.

c. Turn GAIN control fully counterclockwise.

d. Using POS control, set trace drawn by recorder stylus precisely on the centerline of its channel.

e. Turn GAIN control fully clockwise. If the stylus moves from its center position by more than 2/5 of the smallest chart division, reset it to channel

centerline by means of the screwdriver adjustment (Vo trimmer located behind its front panel access hole marked "Vo").

f. Set function switch to Io position. Set screwdriver-adjusted Io control through its identified front panel access hole for a null, the point at which the recorded trace most closely approaches the channel centerline.

g. Connect the Dial-A-Source to the recorder input for the channel being calibrated and set it for 4.000 Vdc. Set the recorder V/DIV, MV/DIV switch (4, figure 2-1) to .1 V/DIV.

h. Set the GAIN control to the position which causes the stylus to trace a line precisely 20 smallest chart divisions to the right of the channel centerline.

i. Reset the Dial-A-Source to 0.000 Vdc and adjust POS control, if necessary, to bring the stylus to the exact channel centerline.

j. Repeat steps h and i until the stylus traces precisely at channel centerline and +20 chart divisions.

k. Set the Dial-A-Source to -4.000 Vdc and verify -20 chart division trace within half a chart division. Refer to the manufacturer's manual if the recorder is out of specified tolerance.

l. Disconnect the Dial-A-Source.

3.3.3 Pen Motor Damping

a. Connect a signal generator HP Model 202A or equal to the recorder input and set it for a one Hertz square wave.

b. Adjust the signal generator and/or signal conditioner controls until the signal is recorded at an amplitude of 48 divisions peak-to-peak at a medium trace width. There should be 1/3 to 1 division overshoot of the stylus in its response to a one Hertz square wave of this amplitude.

NOTE

The stylus heat (trace width) control will affect overshoot. It is only necessary to verify that the specified amount of overshoot is present at a

medium setting of the stylus heat (trace width) control. If insufficient overshoot is present, stylus pressure may be higher than 4 grams. Check and reset stylus pressure if necessary, then recheck overshoot. See chart pattern examples in figure 3-1.

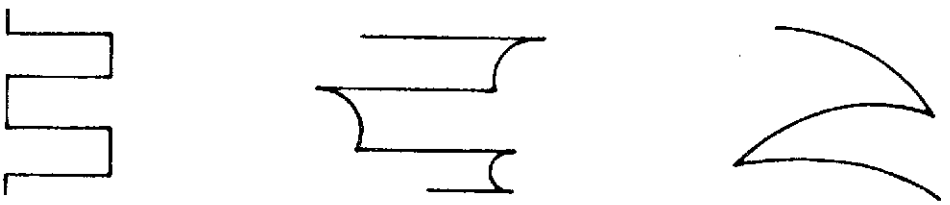


Figure 3-1. Chart Pattern Examples

c. Disconnect the signal generator.

3.4 AMBIENT AIR TEMPERATURE 12AA01: -100° TO +100°C

Transducer: Rosemont Model E102A1
Conditioner: Rosemont Model 510BFU3
115 Vac input, 0-5 Vdc output

Transducer is laboratory calibrated at six-month intervals. The conditioner is calibrated monthly or after installation of a new transducer, using a decade resistance box set to the resistance values given on the Calibration Data Sheet.

a. Set the recorder up in accordance with paragraph 4.7. Disconnect the digital recorder patch.

b. Disconnect the transducer cable and replace the transducer with a decade resistance box.

c. Set the decade resistance box successively for the following resistance values: 0%, 20%, 40%, 60%, 80%, 100%, 80%, 60%, 40%, 20%, and 0%. At each value, allow about one inch of chart paper to run off. Verify that the recorded value is within one small division of calibration value.

d. Reconnect the transducer and return patching to normal configuration.

3.4.1 Rough Check of Ambient Air Temperature

For a rough check of the ambient air temperature, multiply the conditioner output by 40 and subtract 100, e.g., 3.0 Vdc times 40 minus 100 = 20°C. This should be done prior to each flight on the ground and compared to the hangar temperature.

3.5 DEW POINT TEMPERATURE 12AA02: -50° TO +50°C

Transducer/Conditioner: EG&G Model 137-C3 Aircraft Hygrometer System
115 Vac 50W input, 0-5 Vdc output, 10 lb.

a. Transducer and control unit is laboratory calibrated at six-month intervals and requires no field service.

b. Occasionally check the U.S. Weather Bureau dew point (on the ground) against the hygrometer. Multiply the hygrometer output by 40 and subtract 50, e.g., 1.0 Vdc times 40 minus 50 is a -10°C dew point. Log the comparison in the flight log.

3.6 AIRSPEED 45AA01: (±1 PSID) 0 TO 200 MPH

Transducer/Conditioner: Whittaker Model 630490
28 Vdc excitation, 0-5 Vdc output, 2 lb.

a. Transducer/conditioner is laboratory calibrated when out of tolerance in comparison with aircraft instruments.

b. During each flight check the transducer output in flight by multiplying by 40 and comparing with the pilot's airspeed indication, e.g., 2.5 Vdc output times 40 mph/v = 100 mph. Log the comparison in the flight log.

c. Check the calibration with the aircraft airspeed indicator at two speeds at least 50 mph apart within ±5 mph. Log this comparison in the flight log.

3.7 ALTIMETER 45AA02: 0-20K FEET

Transducer/Conditioner: Rosemont 1241-A4CDE
±15 Vdc excitation, 0-5 Vdc output

a. Transducer/conditioner is laboratory calibrated when out of tolerance with the aircraft instruments.

b. During each flight make an in-flight check of the measurement output on the digital multimeter. Convert to altitude by multiplying by 4,000 feet and compare with the pilot's altimeter reading, e.g.,

2.25 Vdc times 4,000 = 9,000 feet altitude. Log the comparison in the flight log.

c. Check the calibration with the aircraft's altimeter of two altitudes at least 1,000 feet apart within ±100 feet. Log this comparison in the flight log.

3.8 RADIOMETER TEMPERATURE 12AA03: -50° TO 0°C, -10° TO +10°C, 0° TO +90°C

Transducer/Conditioner: Barnes PRT-5
115 Vac 20W input, 0-5 Vdc output

a. Transducer and control unit is laboratory calibrated at three-month intervals and requires no field service.

b. Table 3-1 converts recorder output (or multimeter reading % of full scale) to °C for all three scales. Refer to this table during preflight Radiometer checks.

Table 3-1. RADIOMETER RECORDER OUTPUT VS °C

| LOW RANGE | | MEDIUM RANGE | | HIGH RANGE | |
|---|---|---|---|---|---|
| Meter (°C) | Recorder % Full Scale | Meter (°C) | Recorder % Full Scale | Meter (°C) | Recorder % Full Scale |
| -50. | 0.00 | -10. | 0.00 | 0. | 0.00 |
| -49. | 1.34 | - 9. | 4.47 | 1. | 1.56 |
| -48. | 2.72 | - 8. | 9.00 | 2. | 3.14 |
| -47. | 4.11 | - 7. | 13.58 | 3. | 4.73 |
| -46. | 5.54 | - 6. | 18.22 | 4. | 6.35 |
| -45. | 6.98 | - 5. | 22.91 | 5. | 7.98 |
| -44. | 8.45 | - 4. | 27.65 | 6. | 9.53 |
| -43. | 9.95 | - 3. | 32.46 | 7. | 11.29 |
| -42. | 11.47 | - 2. | 37.32 | 8. | 12.98 |
| -41. | 13.02 | - 1. | 42.23 | 9. | 14.68 |
| -40. | 14.59 | 0. | 47.20 | 10. | 16.40 |
| -39. | 16.19 | 1. | 52.23 | 11. | 18.14 |
| -38. | 17.81 | 2. | 57.31 | 12. | 19.89 |
| -37. | 19.46 | 3. | 62.44 | 13. | 21.67 |
| -36. | 21.13 | 4. | 67.64 | 14. | 23.46 |
| -35. | 22.84 | 5. | 72.89 | 15. | 25.27 |
| -34. | 24.56 | 6. | 78.20 | 16. | 27.09 |
| -33. | 26.32 | 7. | 83.56 | 17. | 28.94 |
| -32. | 28.10 | 8. | 88.98 | 18. | 30.80 |
| -31. | 29.91 | 9. | 94.46 | 19. | 32.68 |
| -30. | 31.74 | 10. | 100.00 | 20. | 34.58 |
| -29. | 33.61 | | | 21. | 36.50 |
| -28. | 35.50 | | | 22. | 38.43 |
| -27. | 37.41 | | | 23. | 40.38 |
| -26. | 39.36 | | | 24. | 42.35 |
| -25. | 41.33 | | | 25. | 44.34 |
| -24. | 43.33 | | | 26. | 46.35 |
| -23. | 45.36 | | | 27. | 48.38 |
| -22. | 47.42 | | | 28. | 50.42 |
| -21. | 49.50 | | | 29. | 52.48 |
| -20. | 51.61 | | | 30. | 54.56 |
| -19. | 53.75 | | | 31. | 56.66 |
| -18. | 55.92 | | | 32. | 58.78 |
| -17. | 58.12 | | | 33. | 60.91 |
| -16. | 60.35 | | | 34. | 63.06 |
| -15. | 62.61 | | | 35. | 65.23 |
| -14. | 64.89 | | | 36. | 67.42 |
| -13. | 67.21 | | | 37. | 69.63 |
| -12. | 69.55 | | | 38. | 71.86 |
| -11. | 71.92 | | | 39. | 74.10 |
| -10. | 74.33 | | | 40. | 75.36 |
| - 9. | 76.76 | | | 41. | 78.64 |
| - 8. | 79.22 | | | 42. | 80.94 |

Table 3-1. RADIOMETER RECORDER OUTPUT VS °C (cont'd)

| LOW RANGE | | MEDIUM RANGE | | HIGH RANGE | |
|---|---|---|---|---|---|
| Meter (°C) | Recorder % Full Scale | Meter (°C) | Recorder % Full Scale | Meter (°C) | Recorder % Full Scale |
| - 7. | 81.71 | | | 43. | 83.26 |
| - 6. | 84.23 | | | 44. | 85.60 |
| - 5. | 86.70 | | | 45. | 87.95 |
| - 4. | 89.27 | | | 46. | 90.32 |
| - 3. | 91.98 | | | 47. | 92.71 |
| - 2. | 94.62 | | | 48. | 95.12 |
| - 1. | 97.29 | | | 49. | 97.55 |
| 0. | 100.00 | | | 50. | 100.00 |

3.9 FIELD MILL 39AA01, 39AA02, 39AA03, 39AA04: 13 RANGES TO 500 V/M

115 Vac input, ±2.5 Vdc output

The following procedure must have been performed within one month previous to recording Field Mill flight data. All work on the Field Mill (other than gain, phase adjustment) is laboratory performed.

**CAUTION**

Ensure fan exhaust from 28 volt ground power supply does not blow toward aircraft Field Mills during ground checks.

a. Situate the airplane approximately 200 feet from the hangar, powered up, with a portable Field Mill and control unit (P/N PC2-4981 and PC2-4983) set up well clear of the airplane and any overhead objects (no trees, power lines, or other obstacles extend above a 30° elevation angle as seen from the instrument site).

b. Using a two-conductor cable, connect the portable Field Mill with the strip chart recorder in the aircraft so that FZ of both aircraft and portable unit may be compared.

c. Set the Field Mill Control Panel Range switch for the same range as the portable unit and adjust the FZ gain (R47) on the control panel for the same strip chart reading as the portable unit.

d. The remaining Field Mill calibration is performed during flight. Refer to paragraph 4.9 (preflight) and paragraph 5.3 (in-flight).

# SECTION IV
# PREFLIGHT CHECKOUT

## 4.1 GENERAL

Procedures in this section are used to make operational adjustments and check out the NASA-6 Atmospheric Measuring Station before flight. They are not to be considered a calibration of the equipment (for calibration, see section III).

Before preflight checkout, ensure that test equipment calibration stickers are current and verify that all measurement transducers/conditioners are within their laboratory certified calibration interval.

## 4.2 TEST EQUIPMENT

Following items of test equipment will be required for preflight checkout:

- Fluke 8100A digital multimeter or equivalent
- Dial-A-Source power supply or equivalent

## 4.3 APPLYING POWER TO THE AIRCRAFT

If 28 Vdc power is not connected to the aircraft, obtain permission from the aircraft mechanic to use the ground power supply and perform the following:

a. Connect the ground power supply to a 220 Vac hangar outlet and move power supply to the aircraft.

b. Remove the canvas snap-on power supply cover.

c. With the power supply disconnected from the aircraft, press START (3, figure 2-15).

d. Adjust VOLTAGE ADJUST (6, figure 2-15) for 28.0 Vdc (24.5 Vdc on meter).

e. Press STOP (4, figure 2-15).

f. Enter aircraft and ensure power inverter and all following equipment power switches are OFF:

(1) Strip Chart Recorder (7, figure 2-1)

(2) Field Mill Control Panel (four switches - 5 and 6, figure 2-4)

(3) Digital Recorder (2, figure 2-2)

(4) Hygrometer Control (1, figure 2-6)

(5) Radiometer Control Panel (5, figure 2-8)

(6) VHF-FM Transceiver (3, figure 2-12)

g. From outside of aircraft, connect ground power supply cable to aircraft ground power supply connector located in engine nacelle.

h. Press START and again check the output voltage.

i. Enter the aircraft and check all interconnecting cables (figure 2-13), especially the two dc power cables from the aircraft (these cables are always disconnected and bagged when racks are removed from the aircraft).

j. Energize pilot's cabin power breaker (under cockpit door to right side).

k. Turn power inverter on (up) (2, figure 2-14) and wait for the ac power output lamp to light (1, figure 2-14).

l. Power up per the equipment power switch list in f. above, and turn on test equipment.

NOTE

The Techni-Rite strip chart recorder requires a 15 minute warm-up period before step calibration.

## 4.4 VHF-FM TRANSCEIVER CHECKOUT

NOTE

This procedure will be performed with a technician on ground outside aircraft operating a portable or vehicle-mounted transceiver on Net 102.

a. Connect headset to aircraft intercom system jacks (1, figure 2-11).

b. Set FM/INT switch to the FM position (2, figure 2-11).

c. Set both FM and INT audio switches to the up (on) position (other switches should be off) (3 and 4, figure 2-11).

d. Set VOL control (5, figure 2-11) to about center range.

e. Ensure the VHF/FM transceiver channel selector switch (4, figure 2-12) is in position one (Net 102).

f. Ensure the TONE switch (1, figure 2-12) is down (off).

g. Adjust VOL/OFF (3, figure 2-12) and SQL (2, figure 2-12) for volume and quieting.

h. Call the ground station and verify clear two-way communication.

## 4.5 PATCHING FOR STEP CALIBRATION

NOTE

Two patch boards are provided with the amp patch panel. One patches the transducers to strip chart and digital recorder inputs, and the other patches a Dial-A-Source to these inputs.

a. Release the patch panel latch (6, figure 2-10). Remove the data patch board and install the calibration patch board.

b. Set the Dial-A-Source for 0.00 Vdc, connect it to the digital multimeter and patch board jumpering.

NOTE

Digital recorder inputs cannot be left open. They must either be connected to the calibration source or terminated with a shorting plug at the patch panel; however, when the digital recorder is stopped its inputs are shorted and must be disconnected for any measurement or strip chart recording of transducer outputs.

## 4.6 DIGITAL RECORDER

### 4.6.1 Inserting Tape

a. Check tape certification label and install tape on both cartridges.

b. Inspect tape head, compartment, and cartridge for dust or moisture and clean if required. Ensure the tape pickup coupler is snugly held and centered within the cartridge coupling slot.

c. Rotate the reel to produce tension on the tape, insert the cartridge into the machine and lock it into place.

d. If recorder is not already powered up, press the POWER button momentarily (2, figure 2-2); both POWER and RESET will light.

e. Press COUPLE; COUPLE lights and tape pickup leader is coupled in recorder (audible click).

f. Press RESET; RESET will light.

g. Press and hold LOAD; LOAD will light, RESET extinguishes and leader is drawn onto the takeup reel. Continue to hold LOAD until beginning-of-tape (BOT) marker is reached and LOAD is extinguished.

h. Press RESET; RESET will light.

### 4.6.2 Setting the Clock

a. Depress Enable Clock Set button (8, figure 2-2).

b. Insert a screwdriver into the Decade Select Preset screw (9, figure 2-2) and set it to the first click stop clockwise from vertical.

c. Insert the first digit of the Julian date by depressing the Update and Clock Start button the required number of times; i.e., for the 257th day of the year (Julian date 257), press the button twice, updating the hundreds digit to decimal two.

d. Continue for each digit of the date, hour, minute and second by rotating the Decade Select Preset screw from step one through step nine and updating each digit.

e. Return the Decade Select Preset screw to the vertical position (the clock is now ready to be started).

4.6.3 A to D Converter Checks

a. Press the Mux Advance button (11, figure 2-2) as many times as is required to advance the MUX display (13, figure 2-2) to channel one.

b. Press and release the ADC Digitize button (12, figure 2-2) and read the analog-to-digital converter output count (ADC display - 14, figure 2-2).

c. For each step in the following table, set the Dial-A-Source, check its output on the digital multimeter, and compare the ADC display to the table. The ADC output must be within the limits shown.

| Volts | Decimal Counts | Allowable Deviation Counts | ADC display 10 5 2° |
|---|---|---|---|
| 0.000 | 20 | 1 | 00000 01010 0 |
| 1.000 | 420 | 2 | 00110 10010 0 |
| 2.000 | 820 | 3 | 01100 11010 0 |
| 3.000 | 1220 | 4 | 10011 00010 0 |
| 4.000 | 1620 | 4 | 11001 01111 0 |
| 5.000 | 2020 | 5 | 11111 10010 |

d. Step the ADC through all channels to be used for data with the Mux Advance button and compare the 0 Vdc and 5 Vdc (0% and 100%) outputs per the table in step c. (the same limits apply).

4.6.4 Step Calibration

NOTE

Enter digital recorder start/ stop times in flight log to nearest second.

a. Set the Dial-A-Source for 0.000 Vdc.

b. Press the Update and Clock Start button momentarily to start the clock.

c. Press FMTR ON/OFF (5, figure 2-2) momentarily. Control will light, RESET will extinguish.

d. Allow the recorder to run about 15 seconds, then set the Dial-A-Source to 1.000 Vdc.

e. Repeat step d. for 2.000 Vdc, 3.000 Vdc, 4.000 Vdc, and 5.000 Vdc.

f. Press FMTR ON/OFF momentarily. Control will extinguish on completion of scan.

g. Press RESET.

h. Press EOF; tape will advance approximately 3-1/2 inches.

i. Press RESET. Recorder is now ready for recording.

## 4.7 STRIP CHART RECORDER

### 4.7.1 Recorder Setup

Perform the following after allowing a 15 minute warm-up period:

a. Ensure that feed reel contains an adequate supply of paper for the flight.

b. Ensure that the ZERO SUPPRESS switch is in the center (off) position.

c. Set the V/DIV, MV/DIV (4, figure 2-1) switch to 0.1 V/DIV.

d. Disconnect patching to digital recorder inputs.

e. Set the CHART SPEED MM/SEC switch (6, figure 2-1) to 2.5 mm/sec.

f. Set the Dial-A-Source for 0.000 Vdc output.

g. For channels to be calibrated 0 to 5 Vdc, proceed as follows:

   (1) Adjust the POS potentiometer (3, figure 2-1) to put the stylus trace precisely on the 0% line.

   (2) Set the Dial-A-Source for 5.000 Vdc output.

   (3) Adjust the GAIN potentiometer (2, figure 2-1) to put the stylus trace precisely on the 100% line.

   (4) Return the Dial-A-Source to 0.000 Vdc and repeat steps (1), (2) and (3) until both 0% and 100% traces are precisely on line. Lock the POS and GAIN controls.

h. For channels to be calibrated ±2.5 Vdc, proceed as follows:

   (1) Adjust the POS potentiometer (3, figure 2-1) to put the stylus trace precisely on the mid scale line.

   (2) Set the Dial-A-Source for +2.500 Vdc output.

   (3) Adjust the GAIN potentiometer (2, figure 2-1) to put the stylus trace precisely on the 100% line.

   (4) Set the Dial-A-Source for -2.500 Vdc output and readjust the POS potentiometer to put the stylus trace precisely on the 0% or full scale left line

(5) Repeat steps (2) through (4) until both + and - traces are precisely on line.

4.7.2 Step Calibration

a. Allow a few more inches of chart paper to run off, then put the CHART SPEED switch in OFF position and annotate strip chart "Start Recorder Step Calibration".

b. Set the Dial-A-Source to 0.000 Vdc and turn CHART SPEED switch to 2.5 mm/sec.

c. Allow about one inch of chart paper to run off, then turn CHART SPEED switch to OFF. Annotate "0%".

d. For channels calibrated 0 to 5 Vdc, proceed as follows: Repeat steps b. and c. for 1.000, 2.000, 3.000, 4.000, 5.000, 4.000, 3.000, 2.000, 1.000, and 0.000 Vdc, annotating as 20%, 40%, 60%, 80%, 100%, 80%, 60%, 40%, 20%, and 0%. All recorder traces must fall within 1/2 division of the major lines. If they do not, recorder calibration is required.

e. For channels calibrated ±2.5 Vdc, proceed as follows: Repeat steps b. and c. for +1.000, +2.000, +2.500, +2.000, +1.000, 0.000, -1.000, -2.000, -2.500, -2.000, -1.000, 0.000 Vdc, annotating as +40%, +80%, +100%, +80%, +40%, 0%, -40%, -80%, -100%, -80%, -40%, 0%. All recorder traces must fall within 1/2 division of their proper location. If they do not, recorder calibration is required.

f. Place CHART SPEED switch in the OFF position and annotate "End Step Calibration". The recorder is now ready to record.

g. Reconnect patching for digital recorder inputs.

4.8 PATCHING FOR DATA RECORDING

a. Release the patch panel latch (6, figure 2-10), remove the calibration patch board and install the data patch board.

b. Check the Measurements Components Parts List to ensure that all strip chart and digital recorder inputs are properly patched. Ensure that unused digital recorder channels have a shorting plug installed.

## 4.9 FIELD MILL FUNCTIONAL CHECKS

a. Annotate the Field Mill channels on the strip chart: "FZ nose, FX nose, FX top and FY top".

NOTE

Teflon picks up a negative charge from being rubbed, and the Teflon rod is used on the negative axis of each measurement. The three axes are defined as X positive to right, Z positive up, and Y positive forward of aircraft (see figure 4-1). During the following procedures, no one should move near the aircraft. Extreme care should be used in locating the Teflon rod on the measurement axis, and there must be nothing between the rod and the Field Mill.

b. Charge the Teflon rod by rubbing it on the felt cloth. Place rod one meter directly beneath the Nose Field Mill. FZ meter will deflect positively.

c. Adjust the Field Mill control panel SENSITIVITY and RANGE SELECTOR controls (4, figure 2-4) to bring the FZ indication nearly to full scale on the meter and adjust the PHASE control (2, figure 2-4) to zero the FX meter.

NOTE

Phase may also be balanced by the use of an oscilloscope connected to jack 14 on the back of the Field Mill panel (see Appendix A). Adjust PHASE until exactly one-half of a sine wave appears at this point. Lock the control.

d. Record data on the strip chart and digital recorder by turning CHART SPEED switch to 2.5 mm/sec, pushing the FMTR ON/OFF button, waiting about 30 seconds, then turning the CHART SPEED switch to OFF, and pushing the FMTR ON/OFF button a second time. Press

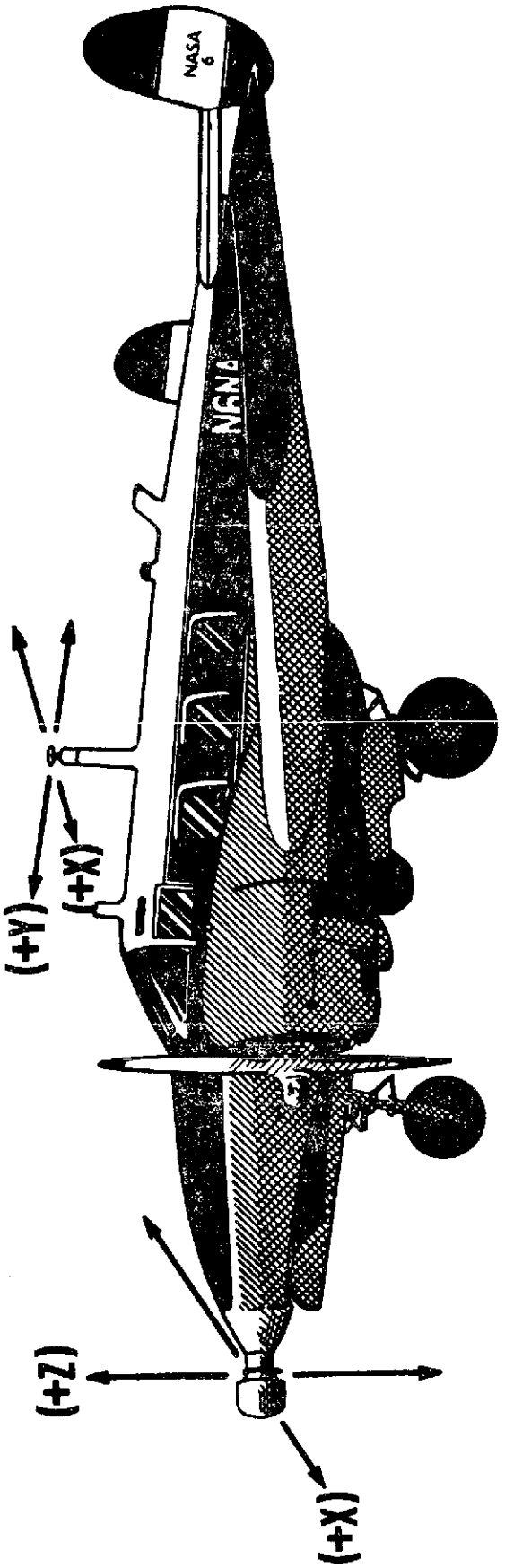


Figure 4-1. NASA-6 Field Mill Configuration

RESET. Annotate the strip chart "Teflon below nose", and indicate the sensitivity range, e.g., "P-6".

e. Place the charged Teflon rod one meter to the left (port side of aircraft) of the Nose Field Mill. FX meter will deflect positively. FZ meter should not deflect.

f. Record about 30 seconds of data as above. Annotate "Teflon to the left of nose" and indicate the sensitivity range.

g. Place the charged Teflon rod one meter to the rear of the Top Field Mill. FY meter will deflect positively. Adjust the PHASE control to zero the FX meter (or adjust PHASE in accordance with "NOTE" after c., above).

h. Record about 30 seconds of data as above and annotate "Teflon behind Top Mill".

i. Place the charged Teflon rod one meter to the left of the Top Field Mill. FX meter will deflect positively. FY meter should not deflect.

j. Record about 30 seconds of data as above and annotate "Teflon to the left of Top Mill".

k. Stop the recorder and set the range switch to position 9. This completes preflight preparation.

## 4.10 MEASUREMENT CHECKS

### 4.10.1 Field Mill Range Switch

a. Patch the digital multimeter into the Field Mill range switch output on the patch panel and unpatch the digital recorder input.

b. Rotate the Field Mill range switch through all positions, making voltage checks per following table:

| Position | Voltage | Position | Voltage |
|---|---|---|---|
| 1 | 0.00 | 7 | 2.50 |
| 2 | 0.42 | 8 | 2.92 |
| 3 | 0.84 | 9 | 3.34 |
| 4 | 1.26 | 10 | 3.76 |
| 5 | 1.68 | 11 | 4.18 |
| 6 | 2.10 | 12 | 4.60 |
| | | 13 | 5.00 |

All values must be within 0.1 Vdc.

c. Unpatch the digital multimeter and repatch the patching removed in step a.

4.10.2 Ambient Temperature

a. Patch the digital multimeter into the ambient air temperature output on the patch panel, unpatch the digital recorder input, and compare the AMBIENT AIR TEMP display (figure 2-5) with the indicated voltage per the following temperature table:

| °C | °F | Vdc |
|---|---|---|
| 10 | 50 | 1.73 |
| 12 | 54 | 1.78 |
| 14 | 57 | 1.83 |
| 16 | 61 | 1.88 |
| 18 | 64 | 1.93 |
| 20 | 68 | 1.98 |
| 22 | 72 | 2.03 |
| 24 | 75 | 2.08 |
| 26 | 79 | 2.13 |
| 28 | 82 | 2.18 |
| 30 | 86 | 2.23 |

Values must be within ±0.025 Vdc.

b. Unpatch the digital multimeter and repatch the patching removed in step a.

4.10.3 Hygrometer

a. Patch the digital multimeter into the dew point (hygrometer) output on the patch panel, unpatch the digital recorder input, and note the multimeter reading.

b. Place the OFF/OPERATE/TEST switch (1, figure 2-6) in the TEST position.

c. Multimeter reading will increase initially, then read a constant value.

d. Unlock the BALANCE potentiometer (3, figure 2-6) and adjust it for a centerline reading on the CONTROL CONDITION meter (2, figure 2-6).

NOTE

If the meter will not reach center scale, the transducer mirror surface is dirty or out of line. This condition must be corrected by the laboratory before valid data can be obtained.

e. Relock the BALANCE control and place the OFF/OPERATE/TEST switch in the OPERATE position.

f. The multimeter reading will drop slowly while the CONTROL CONDITION meter stays at 1.0. The multimeter reading will drop below the reading obtained in step a., then rise to a stable value as the CONTROL CONDITION meter drops to the 0.1 to 0.3 range (high humidity) or 0.5 to 0.9 range (low humidity).

NOTE

Failure of the CONTROL CONDITION meter to drop below 1.0, or of the multimeter reading to show the slight rise above its lowest reading, indicates a measurement problem.

g. Unpatch the digital multimeter and repatch the patching removed in step a.

4.10.4 Airspeed

a. Patch the digital multimeter into the airspeed output on the patch panel and unpatch the digital recorder input.

b. Verify the multimeter reading is 0.00 Vdc ±0.05 Vdc.

c. Unpatch the digital multimeter and repatch the patching removed in step a.

4.10.5 Altimeter

a. Patch the digital multimeter into the altimeter output on the patch panel and unpatch the digital recorder input.

b. Adjust the altimeter ZERO control for 0.00 Vdc.

c. Unpatch the digital multimeter and repatch the patching removed in step a.

4.10.6 Radiometer Mirror

a. Patch the digital multimeter into the radiometer mirror output on the patch panel and unpatch the digital recorder input.

**CAUTION**

Ensure that radiometer mirror is never aimed directly toward the sun.

b. Unlock the mirror locking lever (1, figure 2-9) and rotate the control knob full counterclockwise (mirror down).

c. Verify the radiometer mirror display (3, figure 2-9) reads 180° ±4° and the multimeter indicates a 5.0 Vdc ±0.05 Vdc output from the mirror potentiometer.

d. Rotate the mirror control knob full clockwise (mirror up).

e. Verify the mirror display reads 0° ±4° and the multimeter indicates 0.0 Vdc ±0.05 Vdc.

f. Unpatch the digital multimeter and repatch the patching removed in step a.

g. Clean the radiometer mirror using a nonabrasive glass cleaning liquid and a soft, clean rag.

4.10.7 Radiometer Range Switch

a. Patch the digital multimeter into the radiometer range switch output on the patch panel and unpatch the digital recorder input.

b. Verify a multimeter reading of 5.0 Vdc ±0.5 Vdc for HI range (4, figure 2-8), 2.5 Vdc ±0.5 Vdc for MED range and 0.0 ±0.5 Vdc for LOW range.

c. Unpatch the digital multimeter and repatch the patching removed in step a.

4.10.8 Radiometer Temperature

a. Patch the digital multimeter into the radiometer temperature output on the patch panel and unpatch the digital recorder input.

b. Verify the radiometer FUNCTION switch (5, figure 2-8) is in the ON position, the BANDWIDTH switch (6, figure 2-8) is in the .3 position, and the cavity control meter (3, figure 2-8) is reading in the white portion of the scale.

c. Set the RANGE switch (4, figure 2-8) to HI.

d. Note the temperature indicated on the output meter (1, figure 2-8) and refer to figure 4-2 for the corresponding output voltage. Verify that the multimeter reads within 0.05 volts of that value.

**CAUTION**

Ensure that radiometer mirror is never aimed directly toward the sun.

e. Rotate the radiometer mirror control full counterclockwise. Note a few degrees temperature change on the meter and corresponding change in the output voltage.

f. Lock the mirror in the 180° (down) position.

g. Unpatch the digital multimeter and repatch the patching removed in step a.

4.11 RECORDING AMBIENT DATA

a. Annotate the strip chart "Start Ambient Run".

b. Press the FMTR ON/OFF button on the digital recorder momentarily.

c. Place the strip chart recorder CHART SPEED switch in the 2.5 mm/sec position.

d. Record about three minutes of ambient data.

e. Place the CHART SPEED switch in the OFF position.

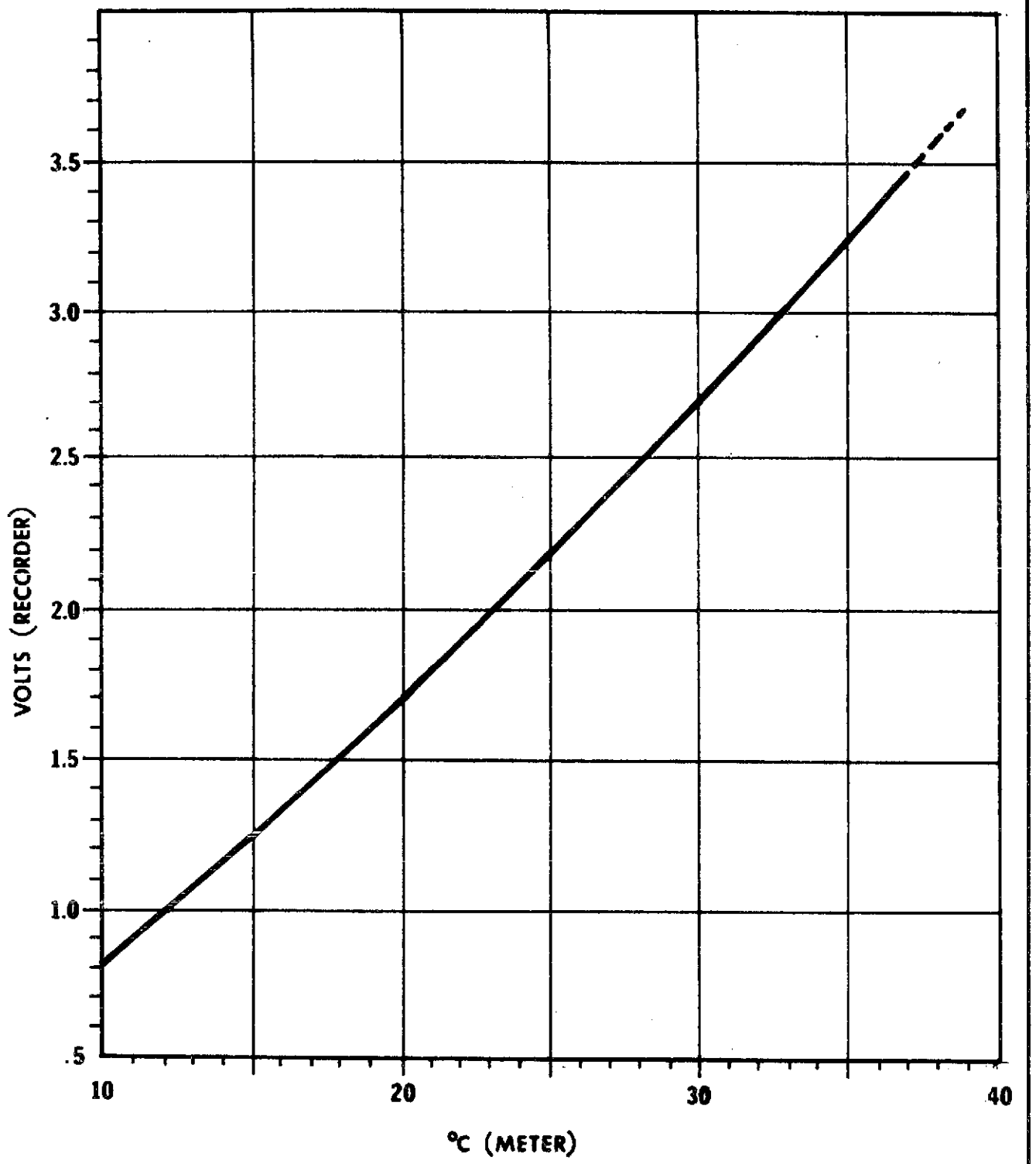


Figure 4-2. Radiometer Output to Recorder

f. Press the FMTR ON/OFF button.

g. Press RESET.

h. Press EOF.

i. Annotate strip chart "End Ambient Run".

4.12 PREPARATION FOR TAKEOFF

a. Power down test equipment and measuring equipment listed in paragraph 4.3.f.

b. Place inverter ON/OFF switch in OFF position.

c. Press stop button on aircraft ground power supply.

d. Disconnect ground power supply cable from aircraft.

# SECTION V
# OPERATION

## 5.1 GENERAL

The following procedures are used to operate the NASA-6 Atmospheric Measuring Station during IN-MSD flight tests. The previous section (Preflight Checkout) must have been performed the day of the test and the system power-down period should not exceed one hour. Strip chart data will be below specified accuracy during the first fifteen minutes after power is returned. No measurement data should be taken for at least five minutes after power is restored.

NOTE

IN-MSD-12A personnel will have briefed measurements crew on flight objectives and measurements required before flight. A complete log of the flight will be kept, including annotation of all maneuvers, digital recorder start and stop times, comparison checks between aircraft and measuring station altimeters and airspeed indicators, names of flight crew, etc. The strip chart should also be annotated with significant flight events.

## 5.2 ROLLOUT AND TAKEOFF

a. Place the aircraft intercom FM/INT (2, figure 2-11) switch in the INT position. Contact the pilot; adjust the VOL potentiometer for comfortable level.

b. Obtain barometric pressure, windspeed and direction and enter in the flight log.

c. After takeoff, the pilot will turn on the cabin power breaker (below cockpit door to right) and notify the instrumentation technician.

d. After notification by the pilot, turn the POWER INVERTER switch on (up) (2, figure 2-14) and wait for the ac power output lamp to light.

e. Power up the following equipment, the digital multimeter and Dial-A-Source:

- ° Strip chart recorder (7, figure 2-1)
- ° Field Mill control panel (four switches - 5 and 6, figure 2-4)
- ° Digital recorder (2, figure 2-2)
- ° Hygrometer control (1, figure 2-6)
- ° VHF-FM transceiver (3, figure 2-12)

f. Place the aircraft intercom system FM/INT switch in the FM position and contact CIF (Room 323) Measurements Station and/or KSC Weather.

g. Adjust the VHF/FM transceiver SQL and VOL/OFF for comfortable listening (leaving the intercom volume control as previously set).

h. Obtain the correct time from the CIF and set the digital recorder clock as follows:

(1) Depress Enable Clock Set button (8, figure 2-2).

(2) Insert a screwdriver into the Decade Selector Preset screw (9, figure 2-2) and set it to the first clock stop clockwise from vertical.

(3) Insert the first digit of the Julian date by depressing the Update and Clock Start button the required number of times, i.e., for the 257th day of the year (Julian date 257), press the button twice, updating the hundreds digit to decimal two.

(4) Continue for each digit of the date, hour, minute and second by rotating the Decade Select Preset screw from step one through step nine and updating each digit.

(5) Return the Decade Select Preset screw to the vertical position.

i. On the appropriate time mark from the CIF, start the clock by pressing the Update and Clock Start button.

j. Press the RESET button; RESET light will illuminate.

## 5.3 FIELD MILL FLIGHT TEST

a. Press the digital recorder FMTR ON/OFF button.

b. Place the strip chart recorder CHART SPEED switch in the 2.5 mm/sec position.

c. Set the Field Mill range switch to give good recorder deflections with no measurement off scale.

d. Annotate the strip chart "Start Flight Maneuvers".

NOTE

Log all maneuvers and the precise timing of them. Maneuvers are to be performed in an unclouded area at less than 5000 feet altitude.

e. Request the pilot to perform a left turn at a constant 45° bank and adjust both Nose Mill and Top Mill FX gain so that the FX meters read the same as the FZ meter. Verify that the strip chart recorder indications are also equal. Continue the left turn for 30 seconds.

f. Request the pilot to fly straight and level for 30 seconds.

g. Request the pilot to perform a right turn at a constant 45° bank for 30 seconds and verify the FX meter deflects negatively the same amount as the FZ meter deflects positively.

h. Request the pilot to fly straight and level for 30 seconds.

i. Request the pilot to climb at a 15° angle and adjust the FY gain control for a reading one-fourth of the level flight FZ reading. Verify that the strip chart recorder indicates the same value. Continue climbing for 30 seconds.

j. Request the pilot to fly straight and level for 30 seconds.

k. Request the pilot to dive at a 15° angle for 30 seconds and verify the FY reading is the same as before, but negative.

l. Request the pilot to fly straight and level for 30 seconds.

m. Turn the CHART SPEED off and press FMTR ON/OFF to stop the tape.

n. Annotate the strip chart "End Flight Maneuvers".

o. Press RESET and EOF. Wait and press RESET again.

## 5.4 NORMAL FLIGHT TEST SUPPORT

NOTE

The following steps are not necessarily presented in order -- they represent typical operations required during flight.

### 5.4.1 S-Band

If the flight is being radar tracked, the S-Band transmitter may be required.

a. Behind rack 2, ensure the antenna coax is connected to the ANT connection of the transmitter to be used (2, figure 2-16).

b. Place the S BAND 1/OFF/S BAND 2 (4, figure 2-16) switch in the up position for transmitter 1 or down for transmitter 2.

c. If no signal is received by the ground, press the circuit breaker button (5, figure 2-16) to reset the 28V power breaker.

d. If still no signal is received, reconnect the antenna to the other transmitter and place the S BAND 1/OFF/ S BAND 2 switch in the opposite position.

### 5.4.2 Recording Data

a. Turn on CHART SPEED switch to 2.5 mm/sec on the strip chart.

b. Press RESET, then FMTR ON/OFF on the digital recorder

c. Log all start/stop times and other significant data in the flight log and on the strip chart.

d. Turn off the CHART SPEED switch.

e. Press the FMTR ON/OFF to stop the tape.

f. Press RESET and EOF (end-of-file to leave blank tape in between data recordings). Wait until the tape stops and press RESET again. The recorders are now ready to be restarted.

g. The recorder will stop automatically when the EOT (end-of-tape) sensor is reached (see paragraph 5.7).

5.4.3 Monitoring Measurements With Multimeter

a. Insert a patch cord from the digital multimeter into the appropriate measurement output (1 through 16) on the system patch panel (figure 2-10), and if the digital recorder is stopped, unpatch its input, being careful not to disturb the measurement patching.

b. Monitor the data on the digital multimeter (0 to 5 Vdc equivalent to 0 to 100% of measurement range).

c. Disconnect the patch cord when not required, reconnect the digital recorder, and again be certain other patching is undisturbed.

5.4.4 Field Mill Range Switch

Whenever data is being recorded, watch all four field strength meters on the Field Mill control panel. Keep the Field Mill range switch in the lowest range that will not allow the strip chart and meters to reach full scale.

5.4.5 Radiometer

a. The radiometer mirror is left locked in the 180° (down) position at all times unless another orientation is specifically requested. When operating the mirror, unlock the lever (1, figure 2-9) and turn the control knob (2, figure 2-9) to set the required angle (0 to 180°) on the numeric display (3, figure 2-9).

b. Start with the radiometer range switch in HI and reduce as required to keep a high, but on scale, meter indication.

c. Check the cavity control meter (3, figure 2-8) occasionally to be sure it stays in the white portion of its range.

d. Before descent to land, lock the mirror in the down position and reset the range switch to HI.

5.4.6 Hygrometer

Check the hygrometer CONTROL CONDITION meter occasionally to be sure it stays within the range 0.1 to 0.9 approximately (0 or 100% reading for long indicates invalid data and a measurement problem).

## 5.5 POST-CALIBRATION

After completion of all data gathering, perform post-calibration of equipment. For convenience, this should be accomplished prior to landing the aircraft.

a. Perform paragraph 4.5, Patching for Step Calibration.

b. Perform paragraph 4.6.4, Step Calibration (for the Digital Recorder).

c. Perform paragraph 4.7.2, Step calibration (for the Strip Chart Recorder).

## 5.6 REMOVING TAPE FROM DIGITAL RECORDER

a. Depress RESET; RESET light is illuminated.

b. Depress and hold REWIND until machine stops.

c. Depress and hold RESET and LOAD for slow rewind until machine stops.

d. Depress and hold RESET and COUPLE until the tape decouples. Release COUPLE and RESET.

e. Unlock the cartridge and remove.

f. For installing a fresh tape, refer to paragraph 4.6.1.

## 5.7 SECURING THE STATION

a. Power down the equipment listed in paragraph 5.2.e. before the pilot turns off the cabin power breaker.

b. Tag the data tapes and strip chart roll "NASA-6" and the date.

c. Enclose the flight log with the data and ensure that they reach Room 323 in the CIF.

d. If either rack is to be removed from the aircraft, ensure that the 28 Vdc aircraft power cable is disconnected and bagged to prevent it shorting out during aircraft use by other agencies.

# APPENDIX A

## FIELD MILL CONTROL PANEL MEASUREMENT PRESENTATIONS

Figure A-1 illustrates the rear of the Field Mill control panel and shows the voltage readings and waveforms to be expected when probes are inserted into various BNC jacks with the charged Teflon rod oriented in the -FZ axis for the Nose Field Mill and the -FY axis for the Top Field Mill. The two sides of the panel are mirror images of each other (Top Field Mill on the left, Nose Field Mill on the right). The two sides share a common 115 Vac power input connector from aircraft power supply. This figure should be referred to when adjusting Field Mill PHASE control.

Top Field Mill J14, J15, J20, J21 signals are illustrated with charged Teflon rod located at -FY axis.



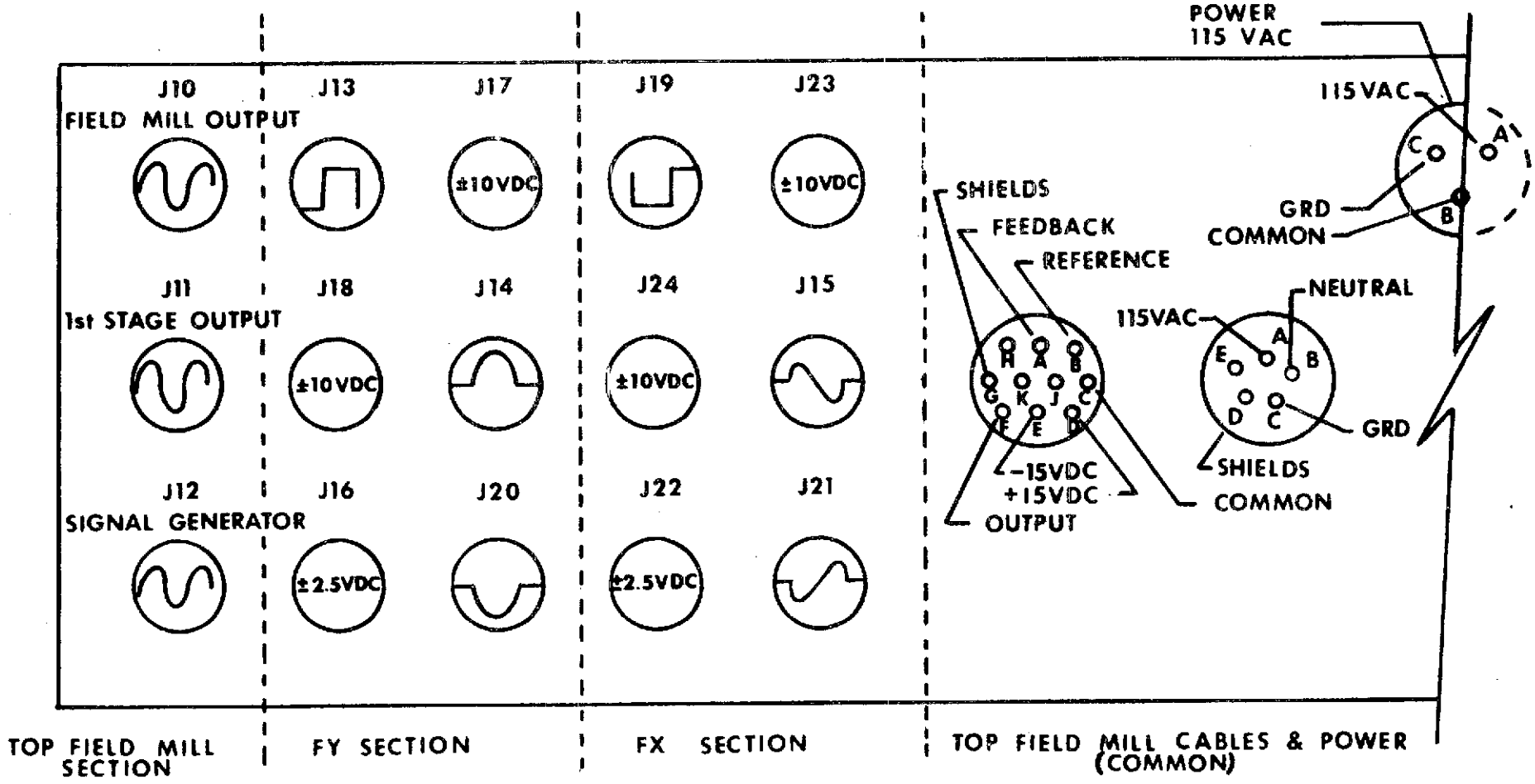


Figure A-1. Field Mill Control Panel Rear Side Test Points (Left-hand)

Nose Field Mill J14, J15, J20, J21 signals are illustrated with charged Teflon rod located at -FZ axis.

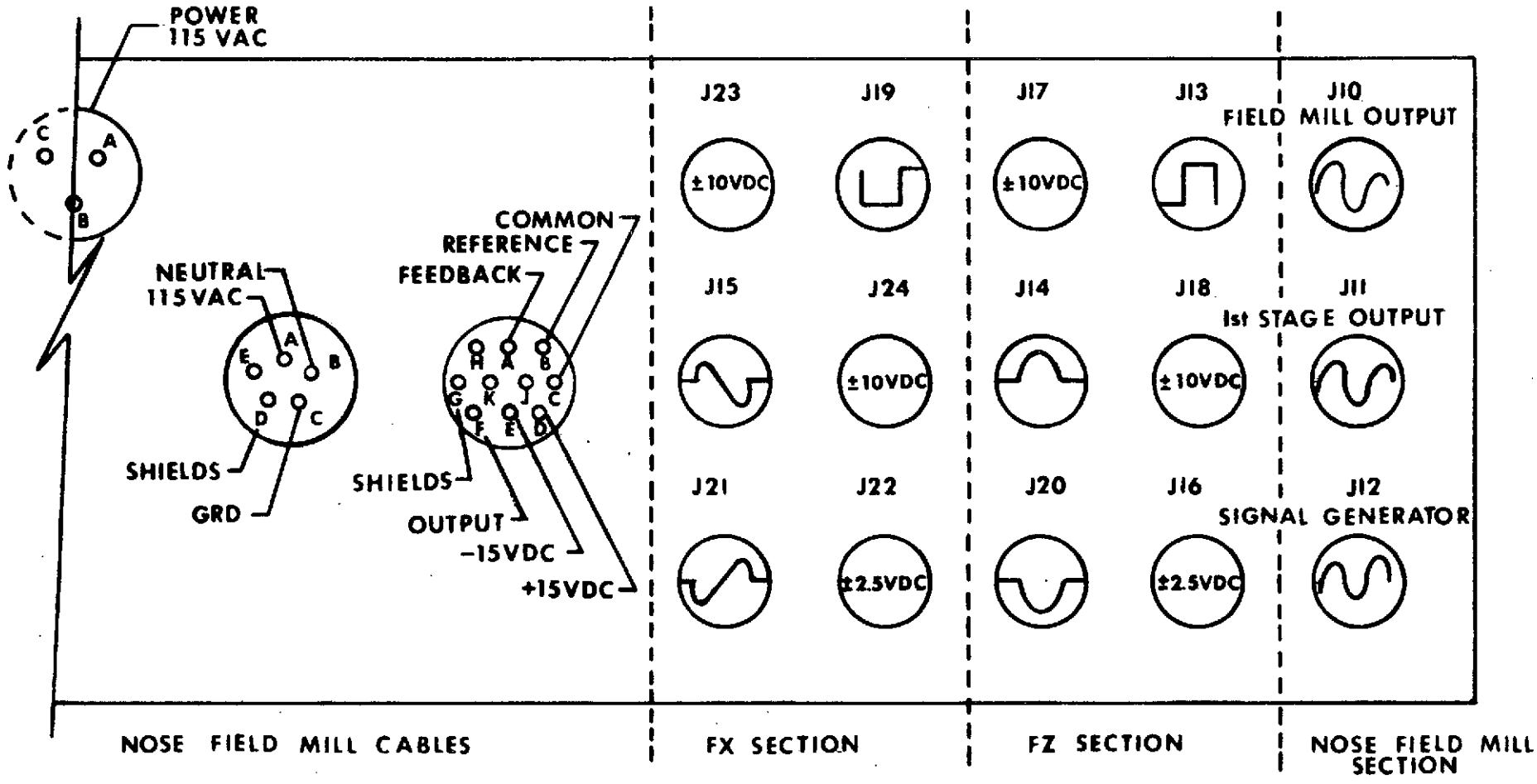


Figure A-1. Field Mill Control Panel Rear Side Test Points (Right-hand)

APPROVAL

NASA-6
ATMOSPHERIC MEASURING STATION

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